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(10) W. Scott/ Mit hell Charles A./ Douglas

STUDY OF
PILOT VISUAL INFORMATION REQUIREMENTS
FOR
NAVY VERTICAL JAKE-OFF AND LANDING
CAPABILITY DEVELOPMENT.

QUANTA SYSTEMS CORPORATION

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STUDY OF PILOT VISUAL INFORMATION REQUIREMENTS FOR NAVY VERTICAL TAKE-OFF AND LANDING CAPABILITY DEVELOPMENT

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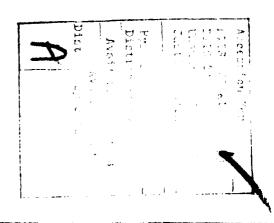
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ABBREVIATIONS

ADF - Automatic Direction Finder
ASR - Air Surveillance Radar
BRC - Base Recovery Course

CTOL - Carrier Take-Off and Landing

EMCON - Emission Control

FLOLS - Fresnel Lens Optical Landing System

FOD - Foreign Object Damage

HIFR - Helicopter In-Flight Refueling

HOBR - Helicopter Onboard Radar

IFR - Instrument Flight Rules
ILS - Integrated Logistic Support

IMC - Instrument Meteorological Conditions
LAMPS - Light Airborne Multi-Purpose System

LSE - Landing Signalman Enlisted
LSO - Landing Signalling Officer
NAEC - Naval Air Engineering Center

NATOPS - Naval Air Training and Operating Procedures Standardization

NAVAIRSYSCOM - Naval Air Systems Command

NAVTOLAND - Navy Vertical Take-Off and Landing Capability Development

PAR - Precision Approach Radar
PIL - Point of Intended Landing
Plant - Point of Intended Landing

PIM - Position and Intended Movement
RAST - Rapid Assist Secure and Traverse
SATS - Short Airfield for Tactical Support

SLED - Helicopter Towed Mine Detection Equipment

TACAN - Tactical Air Navigation
VERTREP - Vertical Replenishment
VFR - Visual Flight Rules
VLA - Visual Landing Aids

VMC - Visual Meteorological Conditions
V/STOL - Vertical/Short Take-Off and Landing

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SECTION I - INTRODUCTION

This report provides a comprehensive analysis of pilot visual landing aid requirements for operation of helicopters and V/STOL aircraft from ship and shorebased sites.

The analytical effort spans a 5 year period commencing in 1974 and reflects the contributions of analyst Mr. R. Richards and Mr. J. Gilstrap of Pacer Systems Corporation, and analyst Dr. C. Freer, Mr. B. Evans and Mr. J. McKinley of Quanta Systems Corporation.

This report and more specifically, the analysis, conclusions, performance requirements and recommendations sections, was prepared by Mr. W. Scott Mitchell and Mr. Charles A. Douglas of Quanta Systems Corporation. The effort was performed under the direction of Mr. T. Momiyama of the Naval Air Systems Command and Dr. R. Shumaker, Mr. M. Kolodner, and Mr. S. Shay of the Naval Air Engineering Center.

The report is organized into eight sections starting with this introduction which further describes the requirement, background and approach to the study. The last four sections detail the terminology used to define pilot information, data tabulated as a result of pilot surveys, and typical existing VLA configurations. The analysis of the pilot data, evaluation of existing sources and identification of deficiencies are discussed in Section II for Helicopters and Section III for the AV-8A. The conclusions of the study, performance requirements and recommendations are described in Section IV.

A. NAVTOLAND PROJECT

The NAVTOLAND project was established to provide an integrated systems approach to improve operational capabilities of the helicopter and V/STOL aircraft employed to shipboard platforms and tactical shorebased sites. Currently, operations are restricted to a 200-foot ceiling, one-half nautical mile visibility, and sea state 3 ship motion limits. The goal of the project is to provide a capability to operate in zero ceiling, one-eighth nautical mile visibility and sea state 5. The project involves a coordinated development of the aircraft flight control and display systems to provide flying qualities with a satisfactory level of pilot workload; shipboard and tactical site installed approach and landing guidance systems; and visual aids to effect a precision touchdown. Further, the project emphasizes developments which can be applied toward improvement of the AV-8 HARRIER and result in a total all-weather and rough sea operation for all future Navy and Marine Corps V/STOL aircraft. The NAVTOLAND project considers a wide range of interacting elements:

- Flight controls/displays
- Guidance sensor system
- Visual Landing Aids
- Ship motion forecasting

- Aircraft hauldown/securing
- Pilot techniques
- Simulation
- Flight test

The development of these elements is directed toward providing the U.S. Navy 1980's and 1990's integrated V/STOL take-off and landing capability.

B. NAVTOLAND VLA ELEMENT

The development of the VLA element of the NAVTOLAND project involves organization of the following factors to guide the pilot:

- Dedicated displays or indicators for specific flight guidance parameters such as glide slope, line-up, attitude, etc. The well-known "meatball" aircraft carrier optical landing system is an example.
- Deck markings and lightings to enhance the pilot's perspective of the landing platform -- e.g., white floodlighting, deck edge and centerline markings and lights.
- Various natural cue elements which singularly or collectively give the pilot some secondary position, speed, attitude and other cues, such as grass on the runway, sea surface.

Within the context of the NAVTOLAND project, the VLA element concentrates on the definition of the necessary VLA package configurations which are:

- Integrated within the total visual scene of the pilot in all of the applicable segments in approach and landing.
- Usable for each class of ship and tactical site and respective V/STOL and/or helicopter operation.
- Standardized across aircraft types, ships and tactical sites as much as possible.

Such VLA packages will consist of:

- Existing lighting and optical systems validated as parts of the package (existing systems which are found to be inadequate, confusing or non-contributing would be eliminated).
- Additional lighting schemes and other visual cue enhancement devices.
- Other optical devices which may be coupled to non-VLA guidance and control sensors such as electronic guidance sensors, aircraft control systems or ship motion sensors.

In reviewing the general arrangement of the currently operational VLA assortment aboard a typical air capable ship, it becomes apparent that there is a substantial number of aids. Many of these aids have been added on piecemeal with quick-patch evolved configurations. It is also apparent that the aids are an extension of the aircraft carrier VLA "know how", which has emphasized precision in approach for the constant speed and constant glide slope CTOL flying requirement (drop-line lights line-up aid and glide slope indicator) rather than precision at touchdown which is essential for V/STOL and helicopter's continuously maneuvering flight. From the standpoint of flying qualities, the following considerations in the V/STOL VLA development are pertinent:

- The lower weather minima of the project goal require increased VLA performance at visual threshold. For varying operational visual threshold ranges, VLA performance requirements for corresponding flying tasks must be met.
- VLA signals must conform to V/STOL and helicopter peculiar, optimized flight paths.
- The pilot's field-of-view limitations and precision final landing maneuvering cue requirements demand closer interface with (smoother transition from) and/or direct use of electronic guidance signals in the VLA design.

C. <u>DEVELOPMENT OF VLA REQUIREMENTS</u>

The development of NAVTOLAND VLA requirements commenced in 1974 by NAEC under contract N68335-75-C-2120 with Pacer Systems Corporation. A Task I report of October 1975 discussed the human factors involved in receiving, processing and responding to visual information in the operational environment; the characteristics of vertical take-off and landing aircraft; and the nature of the visual task from the pilots viewpoint. Of particular importance, the Task I report:

- Identified logical segments of the approach and landing flight phase,
 major piloting tasks within these segments, and the information required to conduct these tasks (see Section V).
- Analyzed the improved LAMPS VLA suite to identify the level and type
 of information which individual component and groups of components in
 that suite rendered in daylight, twilight, and nighttime, for each approach
 and landing segment.
- Compared the information rendered by the LAMPS VLA suite in the nighttime scenario to the information requirements identified for individual approach and landing segments.

A sample Pilot Information Requirements Matrix, prepared as a result of the methodology developed above, is illustrated in Figure 1-1.

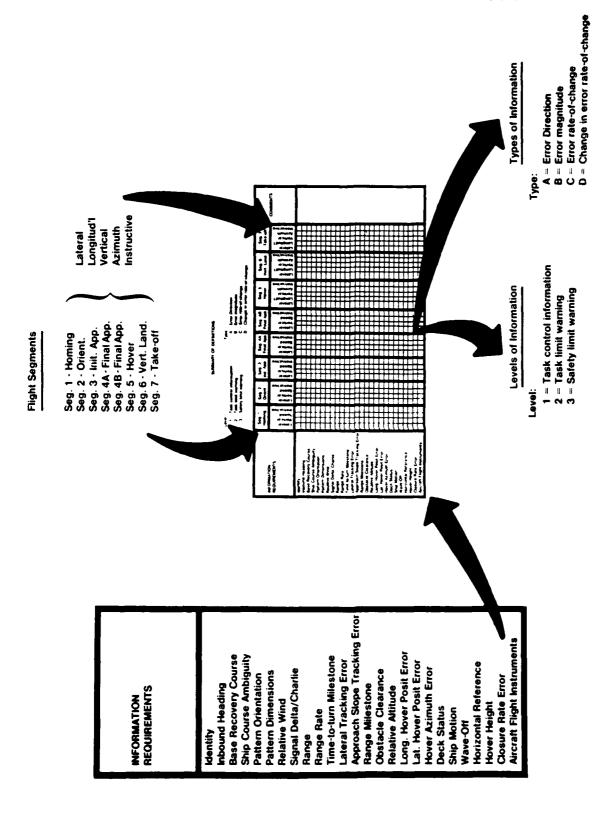


Figure 1-1. Sample Pilot Information Requirements Matrix

The Pacer Systems Corporation effort continued under contract N68335-76-C-2244 and was reported in May 1976 with a Task II report which discussed display requirements. This report identified the major characteristics of VLA devices, related the major characteristics to the VLA requirements, discussed the information requirement categories, outlined the parameters of a VLA devices specification, and described the desired qualities of devices related to each information requirement category.

D. VALIDATION OF PILOT INFORMATION REQUIREMENTS

A validation by Fleet pilots of the information categories and, more specifically, particular information requirements suggested in the Pacer Systems Corporation report, was directed by the project office in 1976. The effort was conducted jointly by Pacer Systems Corporation under contract N68335-76-C-2244 and Quanta Systems Corporation under contract N68335-77-C-1092, and consisted of four tasks:

- 1. <u>Development of Briefing Materials</u>. Briefing materials were prepared for indoctrinating pilots as to the terms and considerations used in the Information Requirements Matrix. The indoctrination material consisted of:
 - a. Briefing narrative with definitions of each term used on the matrix and a discussion of special considerations.
 - b. Briefing aids including transparencies and handouts.
- 2. Development of Pilot Questionnaires. A questionnaire was prepared for the purpose of collecting data pertaining to individual pilot aeronautical qualifications, and registering pilot opinions as to the nature of information requirements. The form for recording the general and aeronautical experience of each pilot included such data as pilot name, squadron type, amount and kind of flight experience, type of aircraft flown, etc.
- 3. <u>Pilot Interviews</u>. The following activities designated by the NAVAIRSYSCOM were visited in 1976:

Date	Activity	Location
11/4	NATC	Patuxent River, MD
11/8	COMHELSEACONWINGONE	NAS Norfolk, VA
11/9	HSL-30, 32, 34	NAS Norfolk, VA
11/10	HM-12	NAS Norfolk, VA
11/11	HC-6	NAS Norfolk, VA
11/22	MAG-32	MCAS Cherry Point, NC
11/23	MAG-29	MCAS New River, NC
11/24	MAG-26	MCAS New River, NC
11/29	HSL-31, 33, 35	NAS North Island, CA
11/30	HC-3	NAS North Island, CA
12/2	MAG-16	MCAS Santa Ana, CA
12/3	DET MAG 16	MCAS Camp Pendleton, CA
12/10	MCAF Quantico	MCDEC Quantico, VA

A lecture of 50 minutes' duration was presented to explain the concepts, terms and considerations of the analysis which had created the Pilot Information Requirements Matrix. The pilots were then requested to make their entries on the forms provided. The forms duplicated the data on the matrices and provided spaces for interviewees to enter changes, comments, additional Information Categories, or enter categories of their own design. The interviewers requested that pilots arrange themselves into groups for mutual discussion of the issues and procedures involved with each information item. As the process began, it was necessary to go through the form, item-by-item, bringing out the relevant considerations: of environment -- black night, no horizon, EMCON; of location as based upon segment definitions; of the need to think only about the kinds of information for specific navigational task management, or safety purposes, without trying to envision the feasible means to visually provide the information (they were not to invent -- only to provide a documentation of required information); and of the concepts serving as the definition of information Levels and Types. Within a short time, the groups, of from 3 to 6 pilots, became self-sustaining in their completion of the forms and could proceed at their own pace. The group interview process was generally completed within two hours.

- 4. <u>Pilot Data Tabulation</u>. Data collected as a result of the pilot interviews was organized and tabulated to reveal the degree of concurrence with the information requirements suggested on the questionnaire. A tabulation of the survey data is presented in Section VI- Pilot Survey of Information Requirements, and Section VII- Pilot Survey Statements.
- a. <u>Pilot Survey of Information Requirements</u> includes a list of the information requirement categories, the ratings suggested to and by the pilots, the number of pilots which agreed or disagreed with each rating, pilot comments associated with a particular rating and engineering comments regarding differences in levels and types of data noted by the pilots. The ratings were annotated with a combination of a circle to indicate that the rating was suggested on the pilot questionnaire by the analyst, a triangle to indicate that the rating was added by the pilot, or a square to indicate that the rating was validated.
- b. <u>Pilot Survey Statements</u> includes the responses to general questions regarding the visual cue sources used during night operations, the adequacy of the present VLA suites and recommendations for improving the VLA.

E. ANALYSIS OF INFORMATION REQUIREMENTS

The analysis of information requirements commenced in September 1978 by Quanta Systems Corporation under NAEC contract N68335-78-C-2022. The analysis involved a tabulation of pilot concurrence with information requirements derived from the validation survey; the evaluation of information sources based on approach profiles and ranges which the sources were visible under different atmospheric conditions; and level and type of cues provided by the sources as compared to the information requirements.

1. Approach Profiles. Typical helicopter and AV-8 approaches during both VFR and IFR conditions used in accordance with NWP-42 and NWP-63 and correlated with

the homing orientation, initial approach, final approach, hover and vertical landing segments defined in the study. This enabled assignment of quantitative range values to each segment aid; thus, assessment of the effectiveness of existing sources of visual information at specific phases of the approach.

- 2. Information Sources. The major sources evaluated for their potential in providing the desired information requirements included: electronic aids, i.e., TACAN, radar, and voice communications; the homing beacon; view of the ship or field; ships wake; deck status lights, wave-off lights; wind sock; landing line-up lights and markings; glide slope indicators; view of the horizon; visual signals; view of obstructions; view of hangar and forward structure; and the LSE/LSO. Typical lighting configurations for LPH/LHA ships, air capable ships and 600' SATS fields are diagrammed in Section VIII.
- 3. Visual Range of Lights. The visual range of lights, such as the homing beacon, were evaluated under different meteorological conditions on the basis of the data indicated in Figure 1-2 for day and 1-3 for night. Using this data, the sources of information were rated as strong, moderate, weak, very weak or as no source. The homing beacon, for example, with an intensity of 1,500 candelas was rated as a strong source at night with 7 mile visibility assuming the pilot had closed to within a few miles of the ship. During the day, however, with the pilot at the same distance from the ship, the homing beacon was rated as no source because it could only be sited when the pilot closed to within approximately 1 mile of the ship.
- 4. Levels and Types of Data. The system for classifying information by level 1, task control; level 11, task limit warning; level 111, safety limit warning; and Type A, error direction; Type B, error magnitude; Type C, error rate of change; Type D, rate in error rate of change, is described in some detail in Section V, Terminology.

Although the concept of information levels is relatively straightforward, the concept of information types required repeated explanation during the validation survey and is, therefore, further explained here.

- a. In order to close to a desired approach path, or point, and thereafter to remain on the desired path, or at the desired point, three conditions must be simultaneously satisfied: first, the displacement of the aircraft from the desired path, or point (the error magnitude), must be zero; second, the rate of change of displacement (error) must be zero; and third, the rate of change of rate of change of error magnitude must be zero.
- b. Rate of change of error can be obtained either indirectly by making periodic observations of error magnitude and (mentally) computing the rate of change or by direct indications of the rate of change of error. Thus, a pilot can fly an aircraft by holding the altitude nearly constant and observing only the altimeter or he can hold the altitude more nearly constant by using both the vertical speed indicator and the altimeter. Similarly, the pilot can determine rate of rate of change by direct or indirect observations.

The question as to whether a device or system yields error magnitude, rate of change of error, and rate of rate of change is dependent not only on the sensitivity of the

VISUAL RANGE OF LIGHTS AS A FUNCTION OF INTENSITY DAY

Meteorological Visibility*	300 feet	700 feet	1/2 mile	1 mile	3 miles	7 miles
Intensity (candelas)			Daytime Visua	l Range (feet)		
10	200	290	420	460	500	520
60	300	470	810	980	1160	1230
100	330	530	970	1190	1460	1 570
1000	480	850	1840	2560	3700	4400
10000	650	1 220	3000	4500	7900	10000
100000	830	1630	4380	7080	14000	22000
106	1020	2050	5890	9940	22000	37000
107	1220	2500	7500	13000	30000	56000
108	1420	3000	9170	16000	40000	76000
109	1620	3430	10900	20000	49000	98000
(1020)	(4000)	(8900)	(31000)	(320000)		

· r = 0.05

Figure 1-2. Visual Range of Lights as a Function of Intensity - Day
VISUAL RANGE OF LIGHTS AS A FUNCTION OF INTENSITY

NIGHT

Meteorological Visibility*	300 feet	700 feet	1/2 mile	1 mile	3 miles	7 miles
Intensity (candelas)			Nighttime Visua	l Range (feet)		
10	270	550	1630	2700	5400°	7900
60	320	. 680	2150	3800	8500	14000
100	330	720	2300	4100	9400	16000
1000	400	890	3030	5600	14000	28000
10000	470	1060	3800	7300	20000	42000
100000	540	1240	4600	9000	26000	59000
106	610	1430	5400	11000	33000	77000
107	680	1610	6200	13000	3 900 0	75000
108	760	1800	7100	1 5000	46000	110000
109	830	1990	7900	17000	53000	130000
(1020)	(1670)	(4200)	(18000)	(38000)	(1 30000)	(360000

* U.S. scale of night visibility

Figure 1-3. Visual Range of Lights as a Function of Intensity - Night

system but also upon the time available for observing the device or system and the frequency with which it can be observed. In this regard, it is easier to obtain information on the rate of change of a variable from an indication of the magnitude of the variable when the indication is of the analog type (a pointer on a meter) than when the information is digital, assuming the device indicating the magnitude is sufficiently sensitive so that one can see movement of the pointer at a glance when the rate of change is significant.

Based on the information requirements identified by the pilots during each segment of the approach profile and the evaluation of the effectiveness of existing sources in providing required information, a comparison was made which resulted in the identification of deficiencies. These deficiencies provided the guidelines for determining the performance of required visual landing aids discussed in Section IV.

SECTION II. HELICOPTER ANALYSIS

This section is divided into three parts. The first part addresses Segment 1 - homing, Segment 2 - orientation, and Segment 3 - initial approach, and requires visual aids which are visible at long range. The second part deals with Segment 4 - final approach and requires visual aids which are visible at a moderate range of about 3 miles. The third part deals with those requirements involving the hover and vertical landing and requires visual aids which provide the necessary cues during the close-in 700' to landing. The analysis conducted in each part begins with a scenario of the operation, the pilot information requirements, evaluation criteria, evaluation of existing sources of information and the identification of deficiencies.

The homing, orientation, initial approach, final approach, hover and vertical landing segments are identified in Figure 2-1 for a typical helicopter approach to an air capable ship.

PART I. HOMING, ORIENTATION AND INITIAL APPROACH

A. SCENARIO

The homing, orientation and initial approach segments are generally defined as follows:

- The homing segment includes the progress to any point from which the pilot undertakes a course to the marshalling position. The marshalling position is a point in space established relative to the ship from which approach procedures such as those using TACAN or radar services, are commenced. If the homing segment is navigated using an approach aid to reach the marshalling position or a holding point directly, the entire portion of the flight to such a position is considered to be in the homing segment. The homing section terminates as the ship is overflown, or, in the instance when the aircraft goes directly to marshall, when marshall is reached.
- The orientation segment includes the localized relative navigation undertaken to reach the marshalling position once the aircraft has arrived in the general area of the terminal site. Included in this segment are any holding or Delta patterns prescribed for control of the aircraft awaiting clearance for an approach.
- The initial approach segment begins upon departure from any marshalling position, holding point, or Delta pattern, and terminates upon completion of adjustments to the direction of flight, altitude and air speed necessary for establishing final approach conditions. For aircraft flying a "racetrack" pattern, this segment includes the up-wind leg of 300 feet on the starboard side of the ship, formation break for landing interval, and the downwind leg to the 180 degree position.

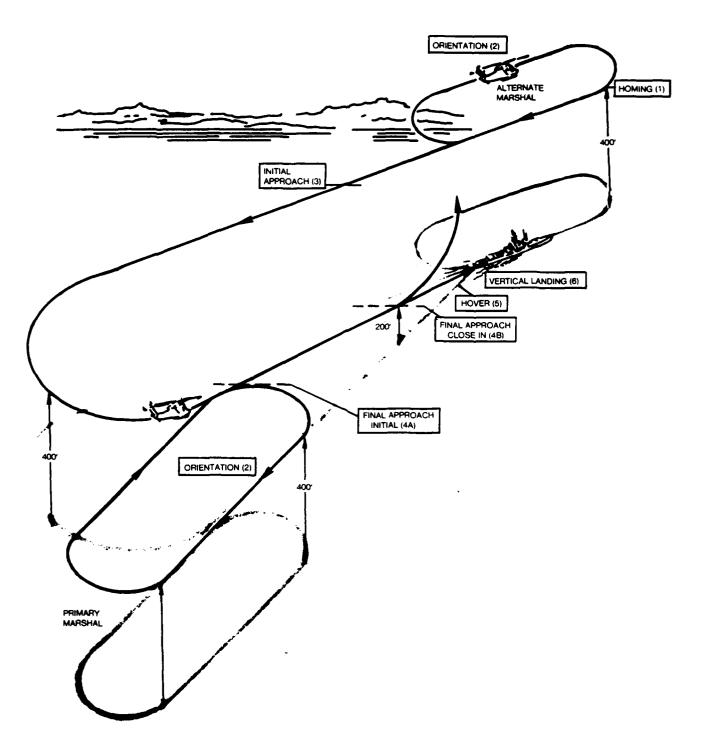


Figure 2~1. Typical Air Capable Ship Landing Pattern for Helicopters

Approach Profile for Helicopters

B. PILOT INFORMATION REQUIREMENTS

The data contained in Figure 2-2 for the homing segment indicates the percentage of Navy and Marine pilots operating both at sea and on shore which agree to the information requirements suggested in the survey. In reviewing the percentages, it appears that there is substantial agreement among the pilots with regard to requiring:

- 1. Identity and inbound heading data to locate the ship.
- 2. Ships course ambiguity, base course recovery, pattern orientation, pattern dimensions, and signal Delta/Charlie data to determine the correct orientation to the ship.
- 3. Range and range rate data to determine the point at which to start the initial approach.
- 4. Deck status, relative wind and ship motion data to determine the situation aboard ship.

A few noteworthy exceptions are discussed below.

- 1. <u>Identity</u> 78% of the VERTREP pilots indicated the need for task limit warning as opposed to task control information. These pilots commented that fuel was particularly critical on long missions and were, thus, more concerned than other pilots in locating the ship immediately.
- 2. Ship Motion This information seems to be important in the minds of many pilots, even at the homing segments, in order that they may mentally prepare themselves for the task ahead. In addition, it appears that interest in ship motion appears to grow as the size of the ship diminishes.
- 3. <u>VERTREP Load Data</u> Many H-46 pilots suggested the need to be aware of this data as a prerequisite for any flight.
- 4. <u>Aircraft Separation</u> Although just a few pilots indicated the need to be aware of aircraft separation, it is noted here because of the importance of this information during multi-aircraft operations.
- 5. Landing Area Size and Shape This information was only requested by one pilot. It is considered significant to note because, like ship motion, pilots are often interested in gaining as much information prior to the time that it is required in order to reduce the anxiety level.

During the orientation and initial approach segments, the information required by pilots remained generally the same, except as noted:

1. Identity, inbound heading, and ships course ambiguity information was not required since it had already been established during the homing segment.

			o.	U.S. Navy At Sea	2		₹	Marines At Sea		Marines At Sea and Share
Information Requirements	Туре	H-2 (Note 1)	H-46 (Note 2)	7 + 46 3 ÷ 3	7-53 Note 4)	T+53 (Note 5)	UH-1/AH-1 H-46 (Note 6) (Note 7	H-46 (Note 7)	T-53 (Note 8)	H-1/H-46/H-53 (Note 9)
Identity	Instructional - Task Control	30%		878	¥001	100%	86%	47%	33%	71%
Identity	Instructional - Task Limit Warning		78%							
Inbound Heading	Lateral - Task Control	% 68	3000	%001	3,001	100%	%96	74%	83%	71%
Ships Course Ambiguity	Instructional - Task Control	% I 9	3001	100%	100%	¥00	100%	%68	75%	8
Base Course Recovery	histructional - Task Control	78%	100%	%001	100%	100%	200%	868	83%	87%
Pathern Orientation	Instructional - Task Control	% %	868	71%	100%		3,001	*	92%	87%
	Lateral - Task Control - Error Magnitude					100%				
Pathern Dimensions	Instructional - Task Control	78%	, 001	300%	100%		100%	3001	826	826
Relative Wind	Instructional - Task Control	93%	3001	86%	3001		%96	% 88	300	87%
	Lateral - Task Control - Error Magnitude					36001				
Signal Delta Charlie	Instructional - Task Control	72%	%/3	71%	%001	3000	100%	100%	83%	%†:
Ronge	Instructional - Task Control	88	- 365 - 365	%001	300	300%	%96	*	1 00%	*88
Ronge Rate	Instructional - Task Control	% 88	¥601	%001	%001	100%	¥00 <u>-</u>	%**	100%	94%
Time-to-turn Milestone	Instructional - Task Control					300%				
Deck Status	Instructional - Task Control	78%	300%	3001	100%		%00I	84%	83%	%0%
Ship Motion	Instructional - Task Control	33%	32%	29%			% 92	2%		%8
VERTREP Load Data	Instructional - Task Control		22%	71%						
Aircraft Separation	Instructional - Task Control					_		%		£
Looding Zone Size & Shape	Instructional - Task Control							_		%
Lateral Tracking Error	Lateral - Task Limit - Error Magnitude					100%				
Approach Slope Tracking Error	Instructional - Task Control					¥00.		-		
Relative Altitude	Instructional - Safety Limit Warning					3001				
Horizonial Reference	Lateral - Speed/Long'l - Task Limit - Rate of Change					100%				
Closure Rose	Speed/Long*1 - Tosk Control - Error Magnitude					100%				ļ

Note 1 - H-2 Operating from Cambatonity, Sample size 19 (See Figure 6-1 series)
Note 2 - H-46 Operating from Auxilibries; Sample size 9 (See Figure 6-4 series)
Note 3 - H-46 Operating from Cambatonity, Sample size 9 (See Figure 6-5 series)
Note 4 - H-35 Operating from Cambatonity, Sample size 7 (See Figure 6-5 series)
Note 5 - H-35 MK 105 Sled; Sample Size 4 (See Figure 6-6 and 6-9 series)
Note 6 - UH-1/AH-1 Operating from LPM/14M; Sample size 8 (See Figure 6-10 series)
Note 6 - H-3 Operating from LPM/14M; Sample size 12 (See Figure 6-11 series)
Note 8 - H-35 Operating from LPM/14M; Sample size 12 (See Figure 6-12 series)
Note 9 - H-1/H-46/H-53 Operating from LPM/14M and Share Boss; Sample size 32 (See Figures 6-13/14/15/16 series)

Figure 2-2. Helicopter Pilot Concurrence with Information Requirements - Homing, Orientation and Initial Approach Segments

- 2. Some pilots conducting VERTREP operations often fly an abbreviated approach pattern as compared with a normal landing and, thus, start to desire information, such as obstacle clearance, relative altitude, hover height, closure rate and wave-off information, during the initial approach segment rather than the final approach.
- 3. Some pilots landing on shore facilities desired information such as approach slope tracking error, obstacle clearance and relative altitude because they were concerned about contacting obstructions.

C. EVALUATION CRITERIA

In order to evaluate potential sources for homing, orientation and initial approach, some criteria had to be established with regard to the distance and altitude of the aircraft from the ship. For this reason two values were assigned. The first value pertains to the distance the helicopter pilot could be expected to fly to the ship without the assistance of navigational aids under EMCON conditions. The value selected for this condition was 3 miles and assumes that the pilot would execute a square search pattern if he does not initially locate the ship. The second value pertains to the distance the helicopter pilot could be expected to fly to the ship with the assistance of navigational aids. The value selected for this condition was assumed to be 1 mile.

Although the pilot normally commences the homing segment at an altitude of 400° to 500°, it was assumed that under EMCON conditions the pilot would fly beneath whatever ceiling existed even if IFR conditions prevailed.

D. EVALUATION OF EXISTING SOURCES

The four sources of information considered essential in the homing, orientation and initial approach segments are rated in Figure 2-3 and discussed below:

1. <u>Electronic Aids</u> – including TACAN, radar and voice communications are strong sources of information for both identifying the ship and determining inbound heading, base course recovery and ships course.

Electronic aids were considered not applicable during EMCON conditions.

2. Homing Beacon - The existing homing beacon with 1,500 candelas provides a strong source at night with 7 mile visibility and, with electronic aids used to close within 1 mile of the ship, a strong source with 1 mile visibility. The homing beacon is not, however, visible during all other conditions. During the day, with 7 mile visibility, for example, the homing beacon cannot be seen even when the helicopter is within 1 mile of the ship. The situation is further complicated as the visibility minimums are reduced. The homing beacon was rated not applicable during IFR conditions with electronic aids because the pilot is flying instruments and not using any external visual sources.

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• Visual signals are not currently used to provide this information.

Not Applicable (NA); Not Visible (NV); Electronic Aids (EA); EMCON (E); strong source (+); weak source (-); very weak source (=); moderate source (blank) Figure 2-3. Evaluation of Existing Information Sources for Helicopters -Homing, Orientation and Initial Approach Segments

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• Visual signals are not currently used to provide this information.

Not Applicable (NA); Not Visible (NV); Electronic Aids (EA); EMCON (E); strong source (+); weak source (-); very weak source (-); moderate source (blank)

Figure 2–3. Evaluation of Existing Information Sources for Helicopters – Homing, Orientation and Initial Approach Segments (continued)

3. View of Ship - The view of the ship provides a strong source during the day with 7 mile visibility. The source deteriorates to a weak source during the day with 1 mile visibility and was rated as not visible under EMCON since the pilot was, by definition, only able to fly within 3 miles of the ship and, therefore, could not see the ship with 1 mile visibility.

At night, the view of the ships navigational lights were rated as a strong source of identity information with 7 mile visibility and the aircraft 1 mile from the ship, and a moderate source with 7 mile visibility and the aircraft at 3 miles from the ship. With 1 mile visibility, however, the view of the ship at night was rated as a weak source at 1 mile and was, of course, not visible under EMCON with the aircraft at 3 miles from the ship.

During IFR conditions, the view of the ship was considered not applicable since the pilot was on instruments and due to the minimums (less than $\frac{1}{2}$ mile visibility) would not see the ship when 1 mile away.

During EMCON conditions, the pilot is presumed to be only within 3 miles of the ship and would be unable to see the view of the ship with visibility minimums of $\frac{1}{2}$ and less miles.

4. Ships Wake - Provides a strong source for identifying the ship during the day under 7 mile visibility and a moderate source during the day under 1 mile visibility. The ships wake is not visible under all other conditions.

E. DEFICIENCY

A summary of the most highly rated visual sources contained in Figure 2-3 are listed in Figure 2-4, excluding any form of electronic aid or visual signals. Based on an analysis of the summary data, the following conclusions can be drawn.

- 1. Under IFR conditions, the pilot can accomplish the homing, orientation and initial approach segments only with the use of electronic aids. Should the aids not be available or if the ship is operating under EMCON conditions the pilot can be, for the purposes of this study, considered under VFR conditions.
- 2. Except for VFR conditions with the visibility above 3 miles, the pilot is unable to acquire the ship and determine inbound heading.
- 3. The pilot may, after acquiring a ship, experience difficulty in differentiating the ships from other ships in the operating area.
- 4. No visual methods currently have been devised to communicate necessary data on base course recovery, ship course ambiguity, pattern orientation, pattern dimensions, relative wind, signal Delta/Charlie, range, range rate, deck status and ship motion under EMCON conditions.

INFORMATION REQUIREMENT	<u> </u>								In	formati	on Prov	rided			
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	LATERAL	LONG./SPD.	VERTICAL	AZIMUTH	INSTRUCT.		FR		₽.		Vf	R	ļ	IFR	
	3	3	>	3	_ ≥	7 mi	1 mi	1/2 mi	700 ft	300 ft	7 mi	1 mi	1/2 mi	700 ft	300 f
Identity *	<u> </u>	<u> </u>			1	1+	NV	NV	NV	NV	1+	NV	NV	NV	NV
Inbound Heading *	18				<u> </u>	1B+	NV	NV	NV	NV	1B+	NV	NV	NV	NV
Base Recovery Course *					1	1+	1	NV	NV	NV	NV	NV	NV	NV	NV
Ship Course Ambiguity *					1	1+	1-	NV	NV	NV	1-	1-	NV	NV	NV
Pattern Orientation *, **					1	1	1	NV	NV	NV	1	1	NV	NV	NV
Pattern Dimensions *, **					1	1	1	NV	NV	NV	1	1_	NV	NV	NV
Relative Wind*, **					1	1	1_	NV	NV	NV	1	1	NV	NV	NV
Signal Delta/Charlie*					1	1	1	NV	NV	77	1	1	NV	NV	NV
Range *, **					1	1	1	NV	NV	77	1-	1-	NV	NV	NV
Range Rate *, **					7	1	1	NV	NV	NV	1	1	NV	NV	NV
Time-to-turn Milestone															
Lateral Tracking Error														ļ	
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Range Milestone						<u> </u>						<u></u>			L
Obstacle Clearance															
Relative Altitude						<u> </u>	<u> </u>					<u> </u>			
Longitudinal Hover Position									L	<u> </u>		ļ		ļ	
Lateral Hover Position														ļ	
Hover Azimuth Error												<u></u>			
Deck Status *					ı	1	1	NV	NV	NV	1	1	NV	NV	NV
Ship Motion *, **					1	1	1	NV	NV	NV	1	1_	NV	NV	NV
Wave off							<u> </u>	<u> </u>	ļ	L	ļ		<u> </u>	<u> </u>	<u> </u>
Horizontal Reference								<u> </u>	<u> </u>			ļ		ļ	<u> </u>
Hover Height												ļ			
Closure Rate Error													<u> </u>		
Aircraft Flight Instruments									<u> </u>				<u> </u>	ļ	
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^{*} Excludes use of Electronic Aids

** Visual signals are not currently used to provide this information

Not Visible - NV

Weak source

Strong source = + Moderate source = blank Very weak source = =

Figure 2-4. Summary of Information Required Versus Information Provided for Helicopters - Homing, Orientation and Initial Approach Segments

PART II. FINAL APPROACH

A. SCENARIO

The final approach involves, for purposes of this study, pilot-controlled adjustments to flight direction, altitude and air speed which are necessary to maintain the desired flight path and speed relative to the terminal site. The segment terminates once the transition to hovering flight is undertaken. The final approach segment is the leg within which landing site facilities become the primary source of visual information for task control. There is a continuity of pilot tasks throughout this segment. Hence, it is treated as an entity; however, the transition from primarily flight-instrument-means to visual site reference warrants a subdivision of this segment. For this reason, the final approach segment is considered in two parts: Segment 4A — the initial portion of the final approach commencing at about 3 miles and terminating at roughly 200 feet and $\frac{1}{2}$ mile; and Segment 4B — the close-in part of the final approach, commencing at $\frac{1}{2}$ mile and terminating at the point when the transition to hover is begun.

For aircraft flying the "racetrack pattern", the final approach segment involves pilot-controlled adjustments to flight direction, altitude and speed to make the turn and descent to intercept the extension of the 45 degree "spike" on the designated landing spot, at which time the segment is terminated. The initial final approach includes all progress to the 45 degree position, and the close-in portion comprises the functions to the point at which the "spike" from the landing spot is intercepted.

B. PILOT INFORMATION REQUIREMENTS

A review of the data contained in Figure 2-5 indicates the information required by the pilots surveyed for the initial and final segments of the final approach. In reviewing the percentages derived, it appears that there is substantial agreement among all pilots in most of the information requirements. Pilots generally agreed that the following information was required:

- 1. Instructional task control data for determining base recovery course, relative wind and ship motion.
- 2. Instructional task control data during initial final approach and instructional safety limit warning data during final approach for determining range milestone, deck status and wave-off.
- 3. Approach slope tracking error, and lateral tracking error for determining rate of change and safety limit warning.
 - 4. Closure rate error data for determining error magnitude.
 - 5. Horizontal reference for determining error rate of change.

			U.S. Navy At Sea	y At Sea		¥	Marines At Sea		Marines at Sea & Share
Information		#-2	‡	±	H-53	UH-1/AH-1	Ŧ	± 53	H-1/H-46/H-53
Requirements	Туре	(Note 1)	(Note 2)	(Note 3)	(Note 4)	(Note 5)	(Note 6)	(Note 7)	(Note B)
Bose Recovery Course	lase Recovery Course Instructional - Task Control	%5&/			%00L/	11%/100%	700%		*6 *
Relative Wind	Instructional - Task Control	72%/70%	%98/%48	814/3/2	300V%001	%96/%96	74%/84%	75%/73%	84%/72%
Lateral Tracking Error	Lateral Tracking Error Lateral - Took Limit Worning - Error Magnitude	100%/100%	100%/100% 100%	/%001	3001/: • 0:	100%/100%	300%\100%\100%\100%	83%/91%	74%/86%
Lateral Tracking Error	Laheral Tracking Error Laheral - Task Limit Warning - Rate of Change			%00L/					14.9
Approach Slope Tracking Error	Vertical - Safety Limit Warning - Error Magnitude	1200	75.68	/%001	/%001	/%96	/%68	83%/	73%
Approach Slope Tracking Error	Vertical - Safety Limit Warning - Rate of Change	700%	700K	%00V	%00V	%00V	7 95%	%00L/	10%/\$6%
Range Milestone	Instructional - Task Control	%	75001	/%001	/%001	/%001	7%56	83%/	/%06
Range Mifestone	Instructional - Task Limit Warning	***	%001/	700%	/100%	*9&/	%5%	%18/	%98/
Deck Status	Instructional - Task Control	78%/75%	∕‱1	300%	3001/%001	100%/89%	28%/ 63%	83%/73%	90%/74%
Deck Status	Instructional - Safety Limit Warning		% 88 %	100%					
Ship Motion	Instructional - Task Control	28%/35%							
Wave Off	Instructional - Task Control	83%/	/‱1	898	/%001	/%001	74%/	83%/	7%/
Wave Off	Instructional - Safety Limit Warning	700%	%00L/	%00L/	%00\/	/100%	%00L/	7.00v	%0%/
Horizontol Reference	Lateral - Speed Longitudinal - Task Control - Error Rate of Change	%00 <i>V</i>	%00L/	%00L/		%00L/	% 5&		%98/
Closure Rate Error	Speed/Longitudinal - Task Control - Error Magnitude	85%/%68	78%/63%	>% [.	/%001	100%/82%	%85/%89	%9%/99% 90%/29%	71%/45%
Closure Rate Error	Speed/Longitudinal - Task Limit Warning - Error Magnitude			%1./	%00L/				6%/J4%
Note 1 - H-2 Operati Note 2 - H-46 Opera Note 3 - H-46 Opera	Note 1 - H-2 Operating from Combatrant, Sample Size 18 pilots Segment 4A and 20 pilots Segment 4B. (See Figure 6-1 series) Note 2 - H-46 Operating from Auxiliaries, Sample Size 9 pilots Segment 4A and 8 pilots Segment 4B. (See Figure 6-4 series) Note 3 - H-46 Operating from Compations, Sample Size 7 pilots Segments 4A and 4B. (See Figure 6-5 series)	ilots Segment 4/	A and 20 pilots A and 8 pilots A and 48. (Se	Segment 48. (Segment 48. (Segme	(See Figure 6-1 See Figure 6-4 eries)	series) series)		LEGEND:	
Note 4 - H-53 Opera	Note 4 - H-53 Operating from LPD's, Sample Size 3 pilots Segments 4A and 4B. (See Figure 6-6 series)	Segments 4A and	14B. (See Fig.	are 6-6 series)	forther of			3 mito j mi	
Note 5 - UH-1/AH-1 Note 6 - H-46 Opers	Note 3 - UH-1/AH-1 Operating from LPTV LINA 3, Somple Size to pilots Segments 4A and 4B. (See Figure 0-10 seres) Note 6 - H-46 Operating from LPH/LHA's, Sample Size 19 pilots Segments 4A and 4B. (See Figure 6-11 series)	eze co pilon se pilots Segments	4A and 48. (5	ee Figue 6-11	a o-to series) series)				

Note 6 - H-46 Operating from LPM/LHA's, Sample Size 19 pilots Segments 4A and 4B. (See Figure 6-11 series)
Note 7 - H-53 Operating from LPM/LHA's, Sample Size 12 pilots Segment 4A and 11 pilots Segment 4B. (See Figure 6-12 series)
Note 8 - H-1/H-44/H-53 Operating from LPM/LHA's and Shore Botes, Sample Size 31 pilots Segment 4A and 29 pilots Segment 4B. (See Figure 6-13, -14, -15, -16 series)

Figure 2-5. Helicopter Pilot Concurrence with Information Requirements -Final Approach Segment

A few noteworthy exceptions are discussed below.

- 1. <u>Base Recovery Course</u> A majority of the pilots indicated a need for base recovery course information during the final approach, presumably as a final up-date before transition to hover.
- 2. Range Milestone A majority of the pilots indicated that a range milestone task limit warning was desired as they closed on the ship during the final approach.
- 3. Deck Status H-46 pilots conducting VERTREP operations considered deck status information extremely important because of the difficulties in aborting the drop at the last second with an external load. In addition, the aircraft is sometimes already at maximum power and is not as maneuverable while carrying the load. Consequently, H-46 pilots indicated that they would rather make an extra trip around than take a wave-off during the hover.
- 4. <u>Wave-Off</u> Pilots agreed they definitely wanted wave-off information before transitioning to hover.
- 5. Ship Motion Information was mainly only of concern to H-2 pilots attempting to operate from combatants while conducting all-weather LAMPS operations.
- 6. Closure Rate Some pilots indicated a need to obtain a task limit warning with regard to closure rate.

The number of pilots indicating a need for other types of data was, in most cases, less than 5% and attributed, in most part, to a lack of completely understanding the pilot information requirements matrix terminology. As with the homing, orientation and initial approach segments, however, many pilots operating to shore bases showed considerable concern with regard to contacting obstructions.

C. EVALUATION CRITERIA

The deck scene (line-up lights, drop-line lights, extended line-up, floodlights, perimeter lights and marking) were not rated individually because data was not collected in sufficient detail to evaluate the cues provided by individual aids except in a general sense.

The PAR is recommended for shooting approaches in conditions of less than 1 mile visibility and 500 foot ceiling. Therefore, the TACAN, ASR and ADF were not rated in Figures 2-6 and 2-7 individually as providing any source of data at the $\frac{1}{2}$ mile or less distance. Should the pilot not visually acquire the ship at a distance of $\frac{1}{2}$ mile, he is waved off. In addition, it should be noted that the PAR does not in itself provide required closure rate information because the closure rate has to be computed by measuring the current speed and distance the aircraft is from the ship and comparing that with the desired speed and distance.

D. EVALUATION OF EXISTING SOURCES

The six basic sources of information considered essential in the final approach segments are rated in Figures 2-6 and 2-7 and discussed below:

- 1. <u>Electronic Aids</u> including TACAN, radar and voice communications were rated as a strong source in providing all required information. The electronic aids were considered not applicable, however, in EMCON conditions and were, therefore, excluded from the analysis summary.
- 2. Deck Status and Wave-Off Lights the existing deck status and wave-off light systems provide a moderate source of deck status and wave-off information at night during the initial Final Approach Segment and VFR minimums. As the pilot closes to $\frac{1}{2}$ mile of the ship and commences the Close-In Segment, the deck status light becomes a strong source of deck status and wave-off information.

During day VFR conditions, it is questionable as to whether or not the deck status light can be readily seen during the initial final approach, although it was rated as a moderate source during the close in portion.

During IFR conditions, the deck status light is barely visible at night with $\frac{1}{2}$ mile visibility and not visible at all under day $\frac{1}{2}$ mile, or day or night 300' and 700' minimums.

- 3. Wind Sock Movements in the wind sock are hardly visible during the initial final approach and only provides a weak source of data during the close in portion whether it is day or night. Even when the wind sock is visible it is difficult to judge the amount of air flow through the sock since the ship is already steaming at 15 to 20+ knots. In addition, it provides an unreliable source of wind direction except when the pilot can view the wind sock from above at a close distance.
- 4. View of the Ship ~ The view of the ship hull and superstructure during the day and, homing beacon and deck lighting in relation to navigational lights at night, provide only marginal visual cues with regard to range milestone, lateral tracking error, approach slope tracking error and closure rate error. The pilot can compare the size of the ship and vertical and lateral position of the ship with respect to the aircraft's window although these cues provide more of a sense of error direction rather than error magnitude. This information comparison is, however, influenced significantly by the side slip and yaw of the aircraft. The source is generally not as good at night as it is during the day because fewer cues are provided. In addition, the ship cannot be seen at all during IFR conditions of 700' and 300' since the initial final approach commences at $\frac{1}{2}$ mile. The view of the ship, however, provides a strong source during the close in portion for ship motion assuming that some horizontal reference such as the view of the ocean is also within the field of view. Some of the pilots indicated that ship motion information would be beneficial during the initial final approach in order to adequately prepare themselves for the conditions at hand. The view of the ship during the close in portion provides a moderate source during the day and only a weak source at night.

REDUMENENT													EVALUATION	3					
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Ship Motion		\vdash	H	_	View of Ship	-	-	<u>-</u>	<u>-</u>	-	_	<u>-</u>	z <u>-</u>	ž	Žį	ž	Ž	Ž	ž
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Not Applicable (NA); Not Visible (NV); Electronic Aids (EA); EMCON (E); strong source (+); weak source (-); very weak source (-); moderate source (blank)

Figure 2-6. Evaluation of Existing Information Sources for Helicopters – Initial Final Approach Segment

REGLARIEMENT													Ž	EVALUATION					
		LEVEL/TYPE	34.										E.	LEVEL/TYPE					
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MEGRAATION	IAN3	8/'9	TUM	UNT	SOUMOS	8	RMA	NORMAL 7 IM. VIS.		5	SPECIAL 1 MR VIS.	Z VS	 -	NORMAL 15 MI. VIS	S IM. VIS.	EINERGENCY	EMERGENCY 300 FT. VIS	MAYTOLAMO	MAYTOLAMO 700 FT. VIS
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Figure 2–6. Evaluation of Existing Information Sources for Helicopters –

Initial Final Approach Segment (Continued)

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Not Applicable (NA); Not Visible (NV); Electronic Aids (EA); EMCON (E); strong source (+); weak source (-); very weak source (=); moderate source (blank)

Figure 2-7. Evaluation of Existing Information Sources for Helicopter – Close–In Final Approach Segment

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Figure 2-7. Evaluation of Existing Information Sources for Helicopter --Close-In Final Approach Segment (Continued)

- 5. Landing Line-up Markings and Lights Landing line-up markings which are floodlit at night and landing lights including extended line-up and drop-line lights provide a poor source for lateral tracking error during the initial final approach but a moderate source as the helicopter closes on the ship during the close in portion. The marking and lights provide only task control information since the pilot does not receive, as desired, a specific visual indication when the task limit is reached. The pilot does, however, readily see if he is to one side or the other of the slot and does receive some indication of error rate of change as adjustments are made.
- 6. Glide Slope Indicator Pilots indicated that they needed a task limit warning and error rate of change with regard to vertical approach slope tracking error. The glide slope indicator was evaluated as only providing task limit information since it fails to specifically indicate a warning such as a flashing light. In addition, the glide slope indicator was rated as only providing error direction information because error magnitude is not provided in a precise manner such as with a spectrum of red, green and amber light, to indicate when the aircraft is, for example, slightly below, moderately below, or extremely below the approach path. Some order of magnitude can be, however, perceived from the three sectors.

In terms of visual perception of the glide slope indicator, it is a strong source during the initial final approach at night with 7 mile visibility, but a weak source with 1 mile visibility. During the day VFR and day or night IFR condition, it cannot be seen. During the close in portion of the final approach the glide slope indicator is a strong source at night and a moderate source during the day under VFR conditions and can barely be perceived during IFR conditions.

E. DEFICIENCY

A summary of the most highly rated visual sources contained in Figures 2-6 and 2-7 are listed in Figures 2-8 and 2-9 excluding any form of electronic aids or visual signals.

1. Perception of Aids - Under IFR conditions, the existing aids are not visible during the initial final approach segment and only barely at the beginning of the close in portion. Therefore, the pilot must either rely on electronic aids or, in the case of EMCON, attempt to fly within visual range of the ship using the square search pattern.

Under VFR conditions of 7 miles visibility, the pilot can perceive the aids relatively well during the day or at night. Under VFR conditions with 1 mile visibility, however, the aids can only be perceived as a strong source as the pilot completes the initial final approach and commences the close in portion.

2. Range Milestone, Closure Rate Error and Ship Motion Information — is provided only by the view of the ship which is at best only satisfactory during the day and rated as a weak source at night. Without a good indication of distance from the ship, it is difficult to establish a range milestone, and thus adjust closure rate.

INFORMATION REQUIREMENT	ŗ								În	formati	on Prov	ided			
	L,	LEV	/EL/T	YPE						Cond	lition				
	l .	PD.	_	_	<u> </u>		De	ву				Ni	ght		
	LATERAL	LONG./SPD.	VERTICAL	AZIMUTH	INSTRUCT		FR	IF	R		VF	R		IFR	
	3	01	KE	Z	SE SE	7 mi	1 mi	1/2 mi	700 ft	300 ft	7 mi	1 mi	1/2 mi	700 ft	300 f
Identity															
Inbound Heading_			L	_											
Base Recovery Course															
Ship Course Ambiguity															
Pattern Orientation										<u> </u>					
Pattern Dimensions															
Relative Wind Update **					1	NV	NV	7	NV	NV	NV	2	NV	2	2
Signal Delta/Charlie															
Range															
Range Rate															
Time-to-turn Milestone															
Lateral Tracking Error	2B					1A	1A	NΥ	NV	NV	1A	1A	NV	NV	NV
Approach Slope Tracking Error			3B			NV	NV	NV	NV	NV	2A+	2A-	NV	NV	NV
Range Milestone					1	1	1	NV	NV	NV	1-	1-	NV	NV	NV
Obstacle Clearance								ļ 							
Relative Altitude									Ĺ						
Longitudinal Hover Position															
Lateral Hover Position				[<u> </u>						
Hover Azimuth Error															
Deck Status *, **					1_	1	1	NV	NV	NV	1+	1+	NV	NV	NV
Ship Motion **					1	1_	1	NV	NV	NV	1-	1-	NV	NV	NV
Wave off					1	1	1	NV	NV	NV	1	1	N	NV	NV
Horizontal Reference															
Hover Height															
Closure Rate Error		18				1A	1A	NV	NV	NV	IA=	1A=	NV	NV	NV
Aircraft Flight Instruments					[[[[ĺ	ĺ	ĺ	1	í	1

^{*} LSE Rating not included

Not Visible

** Voice Rating not included

Strong source

Weak source

Moderate source

Very weak source -

Figure 2-8. Summary of Information Required Versus Information Provided for Helicopters - Initial Final Approach Segment

INFORMATION REQUIREMENT									In	formati	on Prov	ided			
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	Æ	LONG./SPD.	VERTICAL	AZIMUTH	INSTRUCT.	VF		1			VF		j	<u>IFR</u>	
	LATERAL	LONG	VERI	AZIN	INST	7 mi	1 mi	[300 Ft			1/2 mi		300 ft
Identity															
Inbound Heading															
Base Recovery Course **					1										
Ship Course Ambiguity															
Pattern Orientation															
Pattern Dimensions															
Relative Wind **					1	1-	۱-	1-	NV	NV	1-	1-	1-	NV	NV
Signal Delta/Charlie															
Range									<u> </u>						
Range Rate															
Time-to-turn Milestone															
Lateral Tracking Error	2B					10	10	10_	NV	NV	10	10	10	NV	NV
Approach Slope Tracking Error		3C				2A	2A	NV	NV	NV	2A+	2A+	2A-	NV	NV
Range Milestone					2	2-	2-	1-	NV	NV	1	1	1-	NV	NV
Obstacle Clearance															<u> </u>
Relative Altitude														ļ	
Longitudinal Hover Position						,,,,,,,,,,					ļ			.	ļ
Lateral Hover Position										ļ				ļ	
Hover Azimuth Error									<u> </u>	<u> </u>	ļ				<u> </u>
Deck Status *, **					_	1_	1	NV	NV	NV	1	1	1-	NV	NV
Ship Motion					1	1+	1+	1-	NV	NV	1_	1	1-	NV	NV
Wave off *, **					3	3+	3	3-	NV	NV	3+	3+	3	NV	NV
Horizontal Reference	10	10				1C+	10	NV	NV	NV	1C-	1C=	NV	NV	NV
Hover Height										-					
Closure Rate Error		18				1 B	1 B	1A	NV	NV	IA-	1A-	NV	NV	NV
Aircraft Flight Instruments							; 	<u> </u>	 	-	<u> </u>	}			
					,,,				<u> </u>	i	<u> </u>	<u> </u>	1 1	<u>_</u> _	!

^{*} LSE Rating not included ** Voice Rating not included

Not Visible - NV

Weak source - -

Strong source - +

Moderate source - blank

Very weak source - =

Figure 2-9. Summary of Information Required Versus Information Provided for Helicopters - Close In Final Approach Segment

- 3. <u>Line-up Markings and Lights</u> The line-up markings during the day and floodlit markings at night along with the line-up lights fail to provide a task limit warning, although as the pilot closes on the ship during the final $\frac{1}{2}$ mile, he is able to discern error rate of change.
- 4. Approach Slope Tracking Error The glide slope indicator provides approach slope tracking information but fails to provide a precise indication of error magnitude or indication of error rate of change. In addition, the current intensity provides that it can only be seen during night VFR conditions while the pilot is commencing the final approach.
- 5. Deck Status and Wave-Off Lights provide a good source for deck status and wave-off information, although neither can be seen in IFR conditions except during the final $\frac{1}{2}$ mile of the approach.
- 6. View of the Horizon The view of the horizon depends on meteorological conditions. During times of high visibility the view of the horizon provides a strong source, whereas, during 7 miles visibility and less the horizon cannot be seen. The view of the ocean establishes, although, an artificial horizon at the extremities of the visibility. At night, however, the same effect may not be apparent due to the ceiling and light from the moon. It was generally concluded that during a day or night situation with $\frac{1}{2}$ mile visibility and less the view of the ocean would be minimal. The view of the ship was not included as a source since it moves and only provides horizontal information in relationship to the ocean.
- 7. <u>Visual Signals</u> The pilots also indicated the need to be apprised of any changes in base recovery course and relative wind. No aids or procedures have been developed for accomplishing this task visually.

PART III. HOVER AND VERTICAL LANDING

A. SCENARIO

The hover segment begins once transition to hovering flight is undertaken, and includes translational flight to the point from which the VERTREP, HIFR, MK 105 SLED, RAST or vertical landing is commenced. During this segment, flight is conducted primarily by visual reference to the point of intended landing.

The vertical landing segment commences with the aircraft in hover over the touchdown point, and includes the vertical descent, touchdown and any recovery-assist and aircraft securing operations.

B. PILOT INFORMATION REQUIREMENTS

A review of the data contained in Figure 2-10 indicates the percentage of pilots which concurred with the information requirements and ratings suggested in the survey. In reviewing the percentages derived, it appears that there is substantial agreement with regard to the need for:

Except for Note 1A

<u> </u>					Novy of Sea	3.			Ma	Marines of Sea		Marines at Sec & Share
Section Sect	Information Requirements	-M-1	7 t 2	H-2/H-46 (Note 1A)	4 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	7 + 4s (Note 3)	7 ± 53 (Note 4)	7+53 (Note 5)	UH-1/AH-1 (Note 6)		7 + 53 (% 6 8 8)	#=1/#=46/#=53 (Note 9)
Compared Compared	Relative Wind	Lateral – Speed Long'l – Vertical – Azimuth Safety Limit Warning – Error Magnitude	95% / 95%		100%/100%	86%/100%	76001		%%\J00%	%68/%68	36001/36001	3404/4098
Adjusted Selecy Local	Lateral Tracking Error	Lateral - Took Usmit Warning - Rate of Change	/3608		100%/		/%001	/%09	/%001	- /%56	/%001	93%/
Weight Service Long Lo		Lateral - Speed/Lang'l - Vertical - Azimuth Solety Limit Warning - Error Magnitude	300%/300%		100%/100%	86%/100%	300K/100%	/%001	100%/100%			71%/1%
December Consequence Con	Relative Altitude		/%02	29%/67%	78%		/%001		/%001	/%001	/%001	71%/
Lawel - Saky List Warring Lawel - Law Link Warring Lawel - Law Link Warring Lawel - Law Link Warring Lawel - Law Link Warring Lawel - Law Link Warring Lawel - Saky Link Warring Varried - Lak Control/Link	Longitudinal Hover Position	Longitudinal - Task Limit Warning - Change in Error Rote of Change	/3605	29%/67%	100%/		/%001		/%001	/%56	82%/	/%28
Change in Ears Asset of Change S5%/57% S5%/		Longitudinal - Safety Limit Worning- Change in Error Rate of Change	25%/95%	43%/	/100%	*- /67%	/100%		/100 <i>%</i>	/100%	%001/	%5 <i>6</i> /
Lineard - Safety Limit Worming - 23%/33% 43%/ /100% -	Loteral Hover Position	Loteral - Task Limit Worning - Change in Error Rate of Change	/%09		/%001		/%001		100%/	/%68	/%28	/%28
Azimuth - Tota Control/Unial - Error Azimuth - Safey Liait Worning - Bate of Charge and Charge of Grange of Charge of Charge and Charge of Charge and Charge of Charge and Charge of Charge and Charge of Charge and Charge of Charge of Charge and Charge of Charge and Charge of Charge of Charge of Charge of Charge of Charge and Charge of Charge o		Lateral - Safety Limit Warning - Change in Error Rate of Change	25%/95%	43%/	/100%	%/9/	%001/	/%02	/100%	%00L/	/100%	/95%
1100% /10	Hover Azimuth Error	Azimuth - Task Control/Limit - Error Magnitude	85%/20%	29%/33%	%8L/%L9		/%001	100%/	100%/89%	84%/67%	%/9/% 1 9	86%/67%
72% 100%/ 100%/ 13%/- 53%/- 53%/- 55%/ 72% 100%/ 1100%/		Azimuth - Sofety Limit Warning - Rate of Change and Change of				%00L/	%00L/					
7276 100%	Deck Stehus	Instructional - Task Control	/%55	-/ -	/%001		/%001		75%/	53%/	/%55	32%/
72% 100%/ 60%/ 100%/ 100%/ 91%/ 72% 100%/ 60%/ 100%/ 100%/16% 91%/25% 100%/ 60%/ 96%/96% 95%/94% 55%/75% 100%/ 60%/ 96%/96% 95%/94% 55%/75% 100%/ 60%/ 96%/ 96%/ 64%/ 64%/ 64%/ 60%/ 60%/ 64%/ 64%/ 60%/ 60%/ 64%/-		Instructional - Task Limit Werning/ Safety Limit Warning		•	•	/22%					%& :-	/%60
722% 100% /100% 20% /100% /83% /92%	Ship Motion	Loteral - Speed/Long'l - Vertical Task Limit Warning - Rate of Change	/%001	71%/100%	/%001		/%001		-/.	100%/	/% 16	/%68
722% 100%/1 60%/ 100%/ 100%/16% 91%/25% 778% 100%/100% 100%/ 96%/96% 95%/94% 55%/75% 778% 100%/100% 100%/ 96%/96% 95%/94% 55%/75% 770% 770% 6/3%/34% 40%/ 96%/ 6/3%/		Lateral - Speed Lang't - Vertical Task Limit Worning - Change in Error Rate of Change	/10%		7.68/	%L9/	%00L/	20%/	%001/	%c8/	/92%	%98/
778% 100%/100% 100%/ 96%/96% 95%/94% 55%/75% 778% 100%/100% 60%/ 96%/ 58%/ 64%/ 64%/ 7100% 60%/34% 40%/ /93% /67% /67% /92% 100%/ 69%/ 64%/	Wove Off	Instructional - Tosk/Safety Limit Warning	100%/100%	71%/33%	*/9/		/%001	/%09	/%001	%9L/%001	91%/25%	93%/14%
/ 60% 96% 56% 64% 100% 67%/34% 40% 793% 76/% 797% 797% 707% 707% 707% 707% 707% 64%/ 64%/ 64%/ 67%/34% 707%/ 67%/-	Horizontol Reference	Loteral - Toak O	85%/85%	71%/100%	100%/100%	100%/78%	100%/100%	/%/001	%96/%96	95%/94%	55%/75%	*06/*64
1100% 67%/34% 40%/ /93% /67% /92%	Hover Height	Vertical - Task Control - Rate of Change	85%		/%001	43%/			/%96	/%85	/%#\$	/3612
67%/34% 64%/ 64%/ 64%/ 67%/34% 64%/		Vertical - Task Control/Limit - Change in Error Rate of Change	/55%	43%/33%	- 700%	/100%	67%/34%	/%0*	/93%	*/9/	%26/	/86%
67%/34% LEGEND:	Closure Rate Error	Speed/Long'l - Task Limit Warning Error Magnithus	/%55	29%/99%	>> PE	/%/5		/%09	/%68	/%/	/%#9	/%12
LEGEND:		Speed Long*! - Safety Limit Warning Change in Error Rate of Change					67%/34%					
S treating S	· Data Unavailable										LEGEND	
, indicate the second s	Note 1 - H-2 Operation	ng from Combarans, Sample Size 20 pi	lots Segments 5	and 6. (See Fi	igune 6-1 serie	•					Segment 5	Segment 6

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Note 1 - H-2 Operating from Combatents, Sample Stas 20 pilots Segment 5 and 6. (See Figure 6-1 series)

Note 1A - H-2/H-64 HFF, Sample Stas 4 and Jailor seasons 15 and 5 figure 6-2 series)

Note 1A - H-2/H-64 HFF, Sample Stas 4 pilots Segment 5 and 9 pilots Segment 6. (See Figure 6-4 series)

Note 2 - H-64 Operating from Auxiliaries, Sample Stas 7 pilots Segment 5 and 9 pilots Segment 6. (See Figure 6-4 series)

Note 3 - H-45 Operating from LPV, Sample Stas 7 pilots Segment 5 and 9 pilots Segment 6. (See Figure 6-4 series)

Note 5 - H-23 Operating from LPV/LM4's, Sample Stas 8 pilots Segment 5 and 8 pilots Segment 6 and 18 pilots Segment 6. (See Figure 10 series)

Note 6 - LH-1/AH-1 Operating from LPV/LM4's, Sample Stas 8 pilots Segment 5 and 18 pilots Segment 6. (See Figure 10 series)

Note 8 - H-33 Operating from LPV/LM4's, Sample Stas 11 pilots Segment 5 and 18 pilots Segment 6. (See Figure 12 series)

Note 9 - H-1/H-46/H-33 Operating from LPV/LM4's and Stare Bases, Sample Stas 28 pilots Segment 5 and 21 pilots Segment 6. (See Figure 13/14/15/16 series)

Figure 2-10. Helicopter Pilot Concurrence with Information Requirements -Hover and Vertical Landing Segments

- 1. Relative wind
- 2. Deck status and wave-off
- 3. Ship motion
- 4. Obstacle clearance
- 5. Lateral tracking error, relative altitude and closure rate during the hover segment
- 6. Longitudinal, lateral and azimuth hover error and hover height during the hover and vertical landina
- 7. Horizontal reference

A significant point, with regard to the above information, is the tendency on the part of the pilots to require practically the same information for hover and vertical landing except for increased levels and types of data for the vertical landing. Where, for example, pilots indicated a need for task control information during the hover segment, they would indicate a need for task control warning or, even, safety limit warning for the vertical landing segment. The pilots also indicated a similar preference in requesting error magnitude information during the hover segment but error rate of change or, even, change in error rate of change during the vertical landing segment. Other observations are discussed below:

- 1. Hover Azimuth Error was particularly important for helicopters with tandem rotors.
- 2. Deck Status H-46 VERTREP pilots seemed to be particularly concerned about deck status.
- 3. Hover Position Error requirements were particularly important for VERTREP, HIFR and MK-105 SLED operations.

C. EVALUATION CRITERIA

The pilot was considered totally visual during these segments. Problems associated with perceiving cues in various meteorological conditions are nearly non-existent at this range, although sources were generally rated lower at night due to the difficulties in perceiving contrasting and reference information.

D. EVALUATION OF EXISTING SOURCES

The ten basic sources of information for the hover and vertical landing segments are rated in Figures 2-11 and 2-12 and discussed below:

1. Electronic Aids – such as TACAN and radar were not rated during this final phase since these segments are essentially visual even under the worst meteorological conditions.

Voice communications were rated but not, however, during the EMCON condition. It should be emphasized that voice communications are a strong source for obtaining information relative to wind, deck status and wave-off.

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Not Applicable (NA); Not Visible (NV); Electronic Aids (EA); EMCON (E); strong source (+); weak source (-); very weak source (=); moderate source (blank)

Figure 2–11. Evaluation of Existing Information Sources for Helicopters – Hover Segment

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Not Applicable (NA); Not Visible (NV); Electronic Aids (EA); EMCON (E); strong source (+); weak source (-); very weak source (=); moderate source (blank)

Figure 2–11. Evaluation of Existing Information Sources for Helicopters – Hover Segment (Continued)

I. Vis. SPECIAL MIL VIS. NORMAL N. M. VIS. EMERGENCY 300 FT VIS. II. N. M. M. M. M. M. M. VIS. EMERGENCY 300 FT VIS. II. N. N. M. M. M. M. M. VIS. EMERGENCY 300 FT VIS. II. N. N. N. M. M. M. M. M. VIS. EMERGENCY 300 FT VIS. II. N. N. M.	
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NA 1+ NA 1+	
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1	Deck Status Light
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2C+ 2C 2C 2C+ 2C+ 2C 2C 2C+ 2C 1C+ 1C+ 1C- 1C- 1C+ 1C- 1C+ 1C- 1C+ 1C+ 1C+ 1C+ 1C+ 1C+ 1C+ 1C+ 1C+ 1C+	1+
1C+ 1C- 1C- 1C- 1C- 1C- 1C- 1C- 1C-	
10+ 10- 10- 10- 10- 10- 10-	View of Ship 2C+
10+ 10- 10- 10- 10- 10- 10-	-
	Horizon & Sense of Horizon 1C

Not Applicable (NA); Not Visible (NV); Electronic Aids (EA); EMCON (E); strong source (+); weak source (-); very weak source (=); moderate source (blank)

Figure 2–12. Evaluation of Existing Information Sources for Helicopters – Vertical Landing Segment

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	Н	Н			Voice Communications	3+	ž	3+	ž	3+	Ž		¥	3+	3+	3+	3+	3+	3+
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Not Applicable (NA); Not Visi	14	ž	Eleci	Tonic	Not Applicable (NA); Not Visible (NV); Electronic Aids (EA); EMCON (E); strong source (+); weak source (-); very weak source (m); moderate source (blank)	ng sourc	÷	Apen	source	(<u>†</u>	ery we	at source	Ê	moderate soc	rce (blank)				

Figure 2–12. Evaluation of Existing Information Sources for Helicapters – Vertical Landing Segment (Continued)

2. View of the Ship - The view of the ship including the surfaces and markings during the day and the line-up, perimeter lights and floodlit surfaces at night provides the pilot with information for judging relative altitude, hover height, longitudinal hover position error, lateral hover position error, hover azimuth error, closure rate and ship motion. The source can generally be thought of as strong during the day but considerably weaker at night. Under IFR conditions, the view of the ship is visible during both segments except during the beginning of the hover segment when the helicopter is 600' - 700' from the ship and the visibility is 300'.

Although the source itself is, as indicated, fairly strong from a visual standpoint, it generally only provides a task limit warning information since it does not provide the pilot with any type of specific warning when he is too high/low or to either side of the desired approach. In addition, it generally provides an indication of error rate of change as the pilot maneuvers but not change in error rate of change.

- 3. View of Obstructions The view of obstacles provides a strong source during the day and a lesser source at night when the obstacles are floodlit with overhead lights. As the pilot completes the hover and commences the vertical landing, he is unable to see the obstacles which he has cleared and focuses on any obstacles in front of the helicopter, such as the hangar. The view of the obstacles appears to give the pilot an indication of task limit warning and even error rate of change, although pilots indicated that a safety limit warning was necessary.
- 4. View of the Hangar Forward Structure was also only rated as a task limit warning since the pilot does not receive a specific safety limit warning if he should become dangerously close to the hangar. It should be noted that the hangar forward structure provides important depth perception to the pilot as a part of the view of the ship.
- 5. Line-up Markings and Lights Although already discussed in those sources described under view of the ship, are also described here due to their importance. It should be noted that the cues received from these sources are adequate while approaching the ship but are not visible as the pilot hovers over the landing area except for the landing area except for the extended line-up lights and some of the perimeter lights.
- 6. Wave-Off Deck Status Lights Both light systems provide a strong source of instruction information. They can be readily seen except during the beginning of the hover segment with 300' visibility providing an instantaneous safety limit warning.
- 7. Flag Hoist The flag hoist is also a source of deck status information, though not as strong a source or as instantaneous as the deck status light. The flag is not, in many cases, within the visual scan of the pilot.
- 8. Horizon and Sense of Horizon As discussed in the final approach segment, horizontal reference, such as a view of the ocean, is dependent on meteorological conditions. It should also be noted that pilots indicated that only error magnitude as opposed to error rate of change requested during the final approach was required. It is suspected that this differ-

ence in rating is somewhat erroneous in that the pilot would like an indication of error rate of change but has, during the hover and vertical landing segments, started to concentrate solely on the ship. The view of the horizon was rated as a strong source during day VFR but a lesser source during IFR.

- 9. <u>Wind Sock</u> As indicated during the final approach segment, the wind sock is not a very accurate method of providing relative wind, particularly on a moving ship. It is difficult to observe small changes in the wind sock direction and extremely difficult, if not impossible, to sense wind speed.
- 10. Landing Signalman Enlisted The LSE is a primary source of information during day and night operations for the hover and landing segments. He is capable of providing lateral tracking error, obstacle clearance, relative altitude, longitudinal hover position error, lateral hover position error, hover azimuth error, deck status, wave-off and hover height information, although quite often not the type of information required. The LSE can provide a task safety limit warning by indicating a wave-off if he thinks the pilot is too low/high, to the side, or close to an obstruction. In this sense, the LSE is an excellent source of data. The LSE is, however, limited to providing only error direction and, depending on the LSE, some sense of error magnitude by the movement of his hands.

E. DEFICIENCY

A summary of the most highly rated visual sources contained in Figures 2-11 and 2-12 are listed in Figure 2-13 for the hover segment and Figure 2-14 for the vertical landing segment. The summary excludes electronic aids which could not be used under EMCON and visual signals which are not heavily relied upon by some helicopter pilots.

1. Perception of Aids - Under IFR conditions, VLA's are visible during the hover segment commencing at 600' to 700' from the ship except for 300' visibility. In this situation, the pilot must continue to rely on electronic aids or, in the case of EMCON, attempt to fly within visual range of the ship using the square search pattern.

Under VFR conditions of 7 mile or 1 mile visibility, the pilot perceives strong cues during the day and moderate cues at night.

2. Relative Wind - Aside from voice communication, the only indication of relative wind comes from the wind sock which is not visible during the commencement of the hover segment under 300' visibility or, at best, a poor source under even favorable conditions. Furthermore, there is no reasonable visual indication of wind measurement even if ship meteorological equipment is employed. Wind measurement equipment is usually installed on the superstructure which does not provide, according to NWP-42, a reliable source of data for the condition which is occurring on the flight deck. It is also questionable as to how a real time readout would help the pilot since he is likely to feel the effect at the controls as quickly or even more quickly than the equipment could measure a sudden gust of wind.

INFORMATION REQUIREMENT	Ţ						-		ln	formati	on Prov	/ided			
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	E	S	YE	1 27	NS.	7 mi	1 mi		Ţ	300 ft			1/2 mi	700 ft	300 ft
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Inbound Heading															
Base Recovery Course															
Ship Course Ambiguity															
Pattern Orientation			<u>_</u>												
Pattern Dimensions															
Relative Wind **	3B	3в	3 _B	3B		1	1	1	1-	NV	1	1	1	1-	77
Signal Delta/Charlie	·														
Range															
Range Rate												<u></u>			
Time-to-turn Milestone															
Lateral Tracking Error *	2C					2C+	2C+	2C	2C	NV	2C	2C	2C	NV	NV
Approach Slope Tracking Error															
Range Milestone											L				
Obstacle Clearance *	<u>3</u> в	3 _B	3 _B	3B		2C+	2C+	2C+	2C-	NV	2C-	2C-	2C-	2C-	NV
Relative Altitude *			3C			2B+	2B+	2B+	2B-	NV	2B	2B	2B	2B-	NV
Longitudinal Hover Position *		2D				2C+	2C+	2C+	2C+	NV	2C	2C	2C	2C	NV
Lateral Hover Position *	2D					2C+	2C+	2C+	2C+	NV	2C	2C	2C	2C	NV
Hover Azimuth Error *				18		2C+	2C+	2C+	2C+	NV	2C	2C	2C	2C	NV
Deck Status *					1	1+	1+	1+	1+	NV	1+	1+	1+	1+	N۷
Ship Motion *, **	2C	2C	2C			2C+	2C+	2C+	2C+	NV	2C	2C	2C	2C	77
Wave off *, **					3	3+	3+	3+	3+	7	3+	3+	3+	3+	7
Horizontal Reference	1 B	1 B	18			1C+	1C-	1C-	1C-	NV	1C-	1C=	1C=	1C=	NV
Hover Height *			10			1C+	1C+	10	1C	NV	1C-	1C-	1C-	1C-	NV
Closure Rate Error		2B				18	18	1A	1A	NV	1A-	IA-	1A-	1A-	NV
Aircraft Flight Instruments							} 		 +	ļ	ļ	ļ 			
									<u>L_</u>		_	<u></u>	i —		

^{*} LSE Rating not included
** Voice Rating not included

Not Visible - NV Strong source - + not included Strong source - +

Moderate source - blank

Figure 2-13. Summary of Information Required Versus Information Provided for Helicopters - Hover Segment

INFORMATION REQUIREMEN	Ţ								În	formati	on Pro	vided		—_	
		LE	VEL/T	YPE					-	Cone	dition				
		ģ			<u>.</u>		D)av			1	Ni	aht		
	Ambiguity Intation Intaition In														
Identity															
Inbound Heading															
Base Recovery Course															
Ship Course Ambiguity															
Pattern Orientation															
Pattern Dimensions															
Relative Wind **	3B	3B	3в	3B		1	1	1	1	1	1	1	1	1	1
Signal Delta/Charlie											!				
Range															
Range Rate															
Time-to-turn Milestone															
Lateral Tracking Error															
Approach Slope Tracking Error															
Range Milestone															
Obstacle Clearance *	3 _B	<u>3</u> 8	3B	3 _B		2C	2C	2C	2C	2C	2C	2C	2C	2C	2C
Relative Altitude															
Longitudinal Hover Position*		3D				2C+	2C+	2C+	2C+	2C+	2C	2C	2C	2C	2C
Lateral Hover Position *	3D					2C+	2C+	2C+	2C+	2C+	2C	2C	2C	2C	2C
Hover Azimuth Error *				18		2C+	2C+	2C+	2C+	2C+	2C	2C	2C	2C	2C
Deck Status **					1	1+	1+	1+	1+	1+	1+	1+	1+	1+	1+
Ship Motion	2D	20	2D			2C+	2C+	2C+	2C+	2C+	2C	2C	2C	2C	2C
Wave off *, **					3	3+	3+	3+	3+	3+	3+	3+	3+	3+	3+
Horizontal Reference	18	18	1 B			1C+	1C-	1C-	1C-	1C-	1C-	1C=	1C=	1C=	1C=
Hover Height *	10					1C+	1C+	10	1C	1C	1C-	1C-	1C-	1C-	1C-
Closure Rate Error]										
Aircraft Flight Instruments															
				i									l ≔		

* LSE Rating not included

Not Visible

- NV

Weak source

** Voice Rating not included

Strong source - +

Very weak source -

Moderate source - blank

Figure 2-14. Summary of Information Required Versus Information Provided for Helicopters - Vertical Landing Segment

3. Lateral Tracking Error, Relative Altitude and Closure Rate - Line-up markings and lights including extended line-up lights and drop-line lights provide a satisfactory source of lateral tracking error, except for providing a specific type of warning if the pilot strays too far to port or starboard of the desired path. As the pilot comes into a hover over the landing area, however, he loses site of most of the line-up display.

The view of the ship fails to provide the level of information desired by pilots with regard to both relative altitude and closure rate. The view of the ship is even less satisfactory at night.

- 4. Longitudinal Hover Position, Lateral Tracking Position, Hover Azimuth Error, and Hover Height The line-up markings and lights including the extended line-up and drop-line lights provide satisfactory hover azimuth error. However, the markings and lights only provide a sense of error rate of change as opposed to the change in error rate of change desired for lateral and longitudinal hover position. Consequently, the pilot must watch to see the error, wait to see the amount of change and watch to see the extent of change in rate of change. As a result of this situation, it appears that a more instantaneous method is required. With regard to hover height, it appears that the level of information desired increases as the pilot moves into the vertical landing segment, although the existing sources only provide a degree of error rate of change.
- 5. Obstacle Clearance The view of obstacles themselves provides at best a task limit warning but not the desired safety limit warning. No device currently warns the pilot of an impending collision with an obstruction. It is assumed that as a part of the marking criteria that if the pilot hovers correctly he will not contact any obstacles. Following that same logic, if more cues were provided with regard to following the ideal flight path and realizing errors, the less likelihood of contacting obstructions.
- 6. Deck Status and Wave-off It appears that the deck status light and wave-off lights more than adequately provide the necessary instructional data to the pilot provided they are installed in a location where they can be readily observed.
- 7. Ship Motion and Horizontal Reference The view of the ship both during the day and at night provide a satisfactory source of ship motion information until the vertical landing segment when the pilot attempts to sense the actual motions and nulls. In this situation, the pilot desires change of rate of change information but only received rate of change information. Although the horizontal reference provided by the ocean is a strong source during the day, it becomes a weak source during the night and even a weaker source as meteorological conditions approach minimums. Additional horizontal reference information is, therefore, needed.

SECTION III - AV-8A ANALYSIS

Current AV-8A procedures identify four methods of take-off and landing - Vertical Take-off and Vertical Landing, Rolling Vertical Take-off and Rolling Vertical Landing, Short Take-off and Slow Landing, and Conventional Take-off and Conventional Landing. For the purpose of this study, only the more demanding vertical landing operations from forward sites and shipboard platforms are considered.

Typical landing patterns are shown for shorebased VFR (Figure 3-1), for shipboard VFR (Figure 3-2), and for shipboard night IFR (Figure 3-3). As with the analysis contained in the previous section on helicopters, this section is also divided into three parts. The first part addresses the homing, orientation and initial approach and involves visual aids which are visible at long-range. The second part deals with the final approach and requires visual aids which are visible at a moderate range of about 2 to 3 miles. The third part examines the hover and vertical landing and involves visual aids which provide the close-in cues. The analysis conducted in each part begins with a scenario of the operation, the pilot information requirements, evaluation criteria, evaluation of existing sources of information, and the identification of deficiencies.

It should be noted that, unlike the helicopter flight scenario, the AV-8 operation is heavily dependent on navigational aids and voice communications. Further, because of the degree of precision required, LSO techniques, visual aids and radar control are employed during shipboard operations to reduce pilot workload to a reasonable level.

PART I. HOMING, ORIENTATION AND INITIAL APPROACH

A. SCENARIO

The homing, orientation, and initial approach segments are generally defined as follows:

- The homing segment includes the progress to any point from which the pilot undertakes a course to overfly the forward site or ship, or reach the marshalling position. The marshalling position is a point in space established relative to the ship from approach procedures such as those using TACAN or radar services, are commenced. In the instance of IFR, the marshall point is established approximately 15 miles from the ship.
- The orientation segment includes the pass of the forward site or ship and the turn to the down wind leg or any holding or Delta patterns prescribed for control of the aircraft awaiting clearance for an approach. For tactical sites, it is recommended that a clearing/identification pass be made at approximately 250 knots, 1000 feet, into the wind, and off to one side of the site for ease in viewing the landing zone and surrounding area. The pilot is to look for visual cues such as openings in trees and try to become aware of all of the

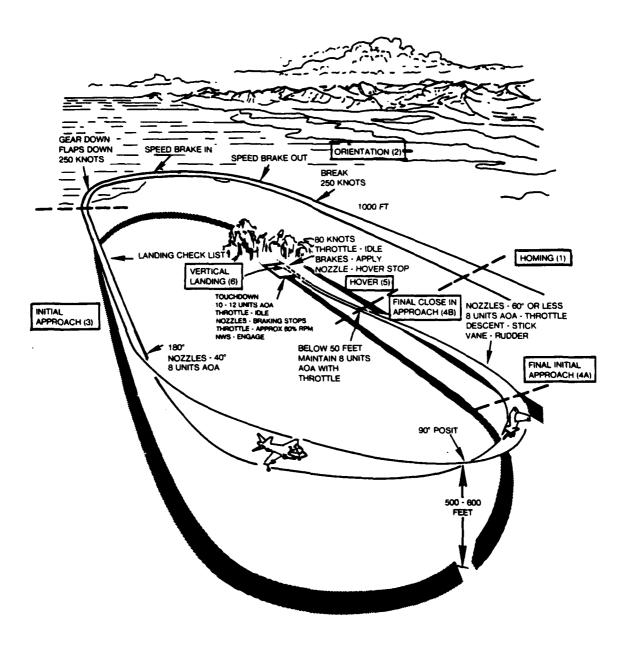


Figure 3-1. Typical Tactical Site VFR Landing Pattern for AV-8A

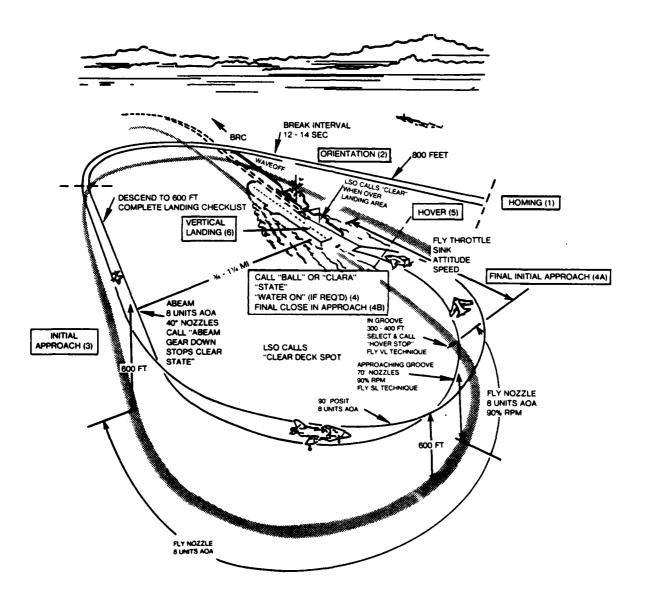


Figure 3-2. Typical Ship VFR Landing Pattern for AV-8A

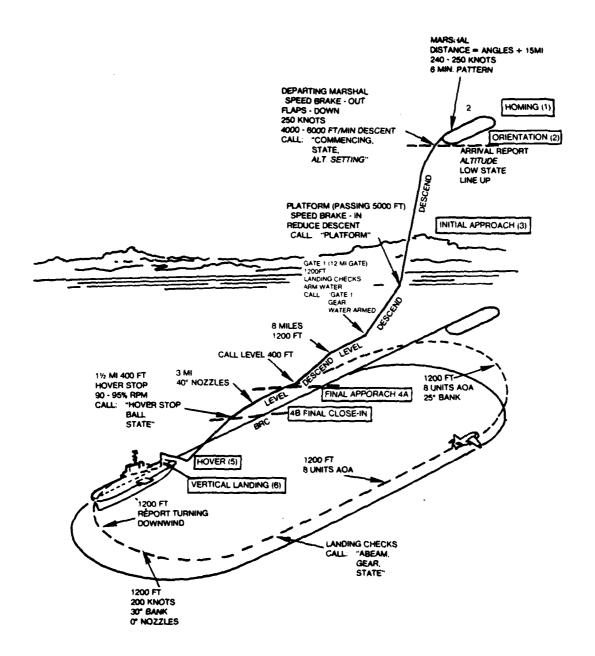


Figure 3-3. Typical Ship IFR Landing Pattern for AV-8A

predominant landmarks surrounding the zone. At approximately 5 to 10 seconds beyond the site, a turn crosswind is commenced in order to keep the zone in sight and adjust the angle of bank so as to arrive at a proper abeam position. The turn to the down wind leg is flown at a constant altitude of 1000 feet and at a constant airspeed to keep pilot workload down. For the ship, it is recommended that the pass under VFR be made at approximately 800 feet altitude with a break interval at 12 - 14 seconds. During night IFR, a 6 minute pattern is flown at 240 to 250 knots.

- The initial approach segment for VFR includes the down wind leg, and final turn and terminates upon completion of adjustments to the direction of flight, altitude and air speed necessary for established final approach conditions. The down wind leg of the pattern for tactical sites is flown at 1000 feet and is used to complete the landing checklist and reacquire visual contact with the landing area and pre-selected visual cues. The down wind leg of the pattern for ship VFR conditions involves flying abeam 3/4 to 1½ miles, completing the landing checklist and descending to 600 feet. The initial approach segment for IFR begins upon departure from the marshalling position at 4000 to 6000 feet per minute descent while maintaining 250 knots. The descent rate is reduced further at platform (5000 feet) until level off at 800 feet and 12 miles. Following departure from platform, the descent rate is progressively reduced so as not to exceed passing altitude in feet per minute. The initial approach is terminated as descent to 400 feet is completed and the aircraft is leveled.

B. PILOT INFORMATION REQUIREMENTS

The data contained in Figure 3-4 for the homing orientation and initial approach segment indicates the percentage of AV-8A Marine pilots which concur with the information requirements suggested in the survey. In reviewing the percentages, it appears that there is substantial agreement among the pilots with regard to the need of:

- 1. Identity and inbound heading information to locate the ship/tactical site.
- 2. Ships course ambiguity, base course recovery, pattern orientation, pattern dimensions, and signal Delta/Charlie information to determine the correct orientation to the ship/tactical site.
- 3. Range and range rate information to determine the point at which to start the initial approach.
- 4. Deck/tactical site status, relative wind, ship motion and density altitude information to determine the situation at the landing site.

A few noteworthy remarks follow:

1. Information for identity, inbound heading, and ships course ambiguity information is not required during the orientation and initial approach segments since it had already been established during the homing segment.

		AV-8A	K
Information Requirements	edζ[Sea (Note 1)	Shore (Note 2)
dentify	Instructional - Safety Limit Warning	%08	%08
Inbound Heading	Lateral - Task Control	100%	*%08
tase Recovery Course	Instructional - Task Control	*%08	%0 8
Ships Course Ambiguity	Instructional - Task Control	300%	100%*, **
Pattern Orientation/Dimensions	Instructional - Task Control	*%08	*%08
telative Wind	Instructional - Task Control	100%*	*%08
Signal Delta/Charlie	Instructional - Task Limit Warning	+%001	*%001
lange	Instructional - Task Control	%001	100%
Ponge Rate	Instructional - Task Control	100%	%001
Seck/Tactical Site Status	Instructional - Task Control	. %001	100%*,
lime-to-turn Milestone	Instructional - Task Control	∙%001	**001
Density Altitude	Instructional - Task Limit Warning	*%08	*%09

Note 1 - AV-8A Marines to LPH/LHA - Sample Size 5 pilots (See Figure 6-17 series) Note 2 - AV-8A Marines to Shore - Sample Size 5 pilots (See Figure 6-18 series)

* Percentage of agreement varied for segments 1, 2 and 3 - Maximum agreement indicated

** Pilots indicate shipboard requirement although data requested was for landbased only

Figure 3-4. AV-8A Pilot Concurrence with Information Requirements - Homing, Orientation and Initial Approach Segments

- 2. Pilots operating to tactical sites desired information such as obstacle clearance and relative altitude because of their particular concern of contacting obstructions.
- 3. The requirement for density altitude was added to the survey forms by a majority of the AV-8A pilots.

C. EVALUATION CRITERIA

In order to evaluate potential sources for homing, orientation and initial approach, some criteria had to be established with regard to the distance and altitude of the aircraft from the ship.

Unlike the helicopter evaluation criteria developed in Section II, AV-8A operational procedures are based on the use of electronic aids such as TACAN, voice communications and radar approach during IFR conditions. Therefore, all visual sources were considered not applicable during these segments because the pilot would not have visually acquired either the ship or tactical site.

D. EVALUATION OF EXISTING SOURCES

The five basic sources of information evaluated in Figure 3-5 for the homing, orientation and initial approach segments are discussed below:

- 1. <u>Electronic Aids</u> including TACAN, radar and voice communications are strong sources of information for both identifying the ship/field and determining inbound heading, base course recovery and ships course/field position.
- 2. Homing Beacon The existing homing beacon with 1,500 candelas provides a strong source at night assuming a visibility of 7 miles and, with electronics aids used to close within 1 mile of the ship, a strong source with only 1 mile visibility. The homing beacon is not, however, visible during all other conditions. During the day, with 7 mile visibility, for example, the homing beacon cannot be seen even when the aircraft is within 1 mile of the ship. This situation is further complicated as the visibility minimums are reduced. The homing beacon was rated not applicable during IFR conditions with electronic aids because the pilot is flying instruments and not using any external visual sources.
- 3. View of Ship The view of the ship provides a strong source during the day with good visibility. At night, the view of the ships navigational lights or tactical site lights was rated as a strong to moderate source of identity information. During IFR conditions, the view of the ship or tactical site was considered not applicable because the pilot is on instruments.
- 4. Ships Wake Provides a strong source for identifying the ship during the day under 7 mile visibility and a moderate source during the day under 1 mile visibility.

REQUIREMENT				П					EVALI	EVALUATION				_
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BEFORMATION		_			Serve		SHIP	SHIPBOARD			BOHS	SHOREBASED		,
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	→	→	_			DAY	NIGHT	DAY	THEM	λ	PHIGHT	À	THOM	,
identify		-		-	Homing Beacon/	Ž	±	ž	ž	ž	÷	ž	Ž	_
	\dashv	-	\Box		View of Ship/Field	÷	-	ž	Ą	÷	_	ž	2	_
	\exists	\dashv	\Box		Ships Wake	÷	Ž	ž	3	₹	₹	ž	Ž	
		_			Electronic Aids	3+	3+	3+	÷	÷	÷	÷	3	_
		\dashv												
Inbound Heading	-	-	\Box		Homing Beacon	ž	±	¥	ž	ž	÷	ž	¥	
	_	+			View of Ship/Field	÷	-	Ž	¥Z	+1	ı	4 Z	ž	
	\exists	4	\Box		Ships Woke	÷	Ž	¥	¥	ž	¥Z	ž	ž	`
	\dashv	4			Electronic Aids	+	±	+	+1	- +1	÷	÷	÷	
Benefiting VFR ratings are	no pass	is a V	ilot	ovin	lot having found the ship									_
		\dashv												
Bose Recovery Course				-	View of Ship/Field	÷	1	NA	ΑΝ	+	-	Ž	Ž	
					Ships Wake	÷	ž	NA	NA	*	-	ž	Ž	
	_	\dashv			Electronic Aids	1+	1+	+1	÷	+1	+1	ئ	:	_
		_											-	_
Ships Course/Field Ambiguity				-	View of Shig/Field	+	1	NA A	¥	•	_	¥	₹	
	_	4			Ships Woke	÷	Ž	ž	¥	¥	Ž	٧N	¥	
		4			Electronic Aids	÷	÷	<u>+</u>	+	1+	1+	+1	÷	
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		4												
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NOT ARREST (NAT. NAT. VIOLET (NAT.)		-	•	-	And the second second second second	A								5

Not Applicable (NA); Not Visible (NV); strong source (+); weak source (-); very weak source (m); moderate source (blank)

Figure 3-5. Evaluation of Existing Information Sources for AV-8A - Homing, Orientation and Initial Approach Segments

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			#	LHSM	+2	ž		+1	٧N	٧N		+1	¥	+	¥		±	¥		2+									
		SHOREBASED	•	AVO	2 +	¥		+1	¥Z	٧N		+1	¥	1	ž		1+	ž		2+									
		MONS	WFR	LHSM	+2			+1	-1	AN		1+	1-	1+			1+	1		2+									
EVALUATION	LEVEL/TYPE		٠ .	DAY	2+			+1	1	1		+	1	+			1	+1		2+									
EVAL	LEVE		F B	MGHT	2+	ž		±	Ž	Ž		±	¥	<u></u>	Ź		±	2		2+		i							
		SHIPBOARD	•	DAY	2+	NA N		+	¥	NA		±	NA	±	ž		±	NA		2+									
		SHES	VFR	MIGHT	2+	2		+	-1	λ		÷	١-	÷			+	1		3;									
				DAY	2+	2-		±	-	1		÷		÷			+	÷		2+									
			anane -		Electronic Aids	Visual Signal		Electronic Aids	View of Ship/Field	Ships Wake		Electronic Aids	View of Ship/Field	Electronic Aids	Visual Signals		Electronic Aids	View of Ship/Field		Electronic Aids									
П		7	JUR.	LSNI	2			-				-		-			-			2									
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$\ \ $	LEWEL/TYPE		S/'9	_		-	\dashv	-		\dashv	\dashv	\dashv	_	 \dashv		_		_			\dashv	\dashv	 Н		-	-	-	Н	\vdash
			IVU:	_	\dashv	\dashv	\dashv	\dashv			\vdash	\dashv	٦	\vdash			\vdash			\vdash	\dashv	7		-		\vdash		\vdash	\vdash
RECUMRENCENT					Signal Delra/Charite			Roge				Brige Rate		Deck/Field Stons			Time-to-Turn Aslestone			Density Altitude									

Not Applicable (NA); Not Visible (NV); strong source (+); weak source (-); very weak source (m); moderate source (blank)

Figure 3–5. Evaluation of Existing Information Sources for AV-8A – Homing, Orientation and Initial Approach Segments (continued)

5. <u>Visual Signals</u> – provide a strong source at night and a moderate source during the day in the case of EMCON or lost communications. The signals are described in NWP-63-1 and include; BINGO, add power, CHARLIE, DELTA, closed ship, do not land, lower wheels, lower flaps, jettison disposable fuel tank and jettison ordnance.

Another source of information, although not a visual source, is the pre-flight briefing and the standard procedures already contained in NWP-63-1 regarding standard patterns orientation, pattern dimensions, and time to turn milestones.

E. DEFICIENCY

A summary of the most highly rated visual sources contained in Figure 3-5 are listed in Figure 3-6, excluding any form of electronic aid or visual signals. Based on an analysis of the data, the following conclusions are drawn.

- 1. Under IFR conditions, the pilot can accomplish the homing, orientation and initial approach segments only with the use of electronic aids. Should the aids not be available, or if the ship is operating under EMCON conditions, the pilot can be, for the purposes of this study, considered under VFR conditions. In this situation, the pilot must navigate by dead reckoning to the best position and then fix appropriate triangles.
- 2. Except for VFR conditions with the visibility above 3 miles, the pilot is unable to acquire the ship and determine inbound heading.
- 3. The pilot may, after acquiring a ship, experience difficulty in differentiating the ships from other ships in the operating area.
- 4. Current signals do not allow for visual communication of data on base course recovery, ship course ambiguity, pattern orientation, pattern dimensions, relative wind, range, range rate.

PART II. FINAL APPROACH

A. SCENARIO

The final approach involves, for purpose of this study, pilot-controlled adjustments to flight direction, altitude and air speed which are necessary to maintain the desired flight path and speed relative to ship or tactical site. The segment terminates once the transition to hovering flight is undertaken. The final approach segment is, therefore, the leg within which landing site facilities become the primary source of visual information for task control. There is a continuity of pilot tasks throughout this segment. Although it is treated as an entity, the transition from primarily flight-instrument-means to visual site reference warranted a subdivision of the segment. For this reason, the final approach segment is considered in two parts: Segment 4A -- the initial portion of the final approach for VFR commences as the aircraft is in the groove at approximately $1\frac{1}{2}$ miles from the landing area at an altitude of 300 to 400 feet. The initial approach segment for IFR conditions assumes

Information Descript	т—												
Information Required	 		/FI /F	VDF		·	 -		<u>in</u>	formati		∕ided	
		LEV	EL/T	TPE						Cond	dition		
		LÖNG./SPD.	a	=	C .		D	ау			N	ight	
	LATERAL	\ \ \ \ \ \	VERTICAL	AZIMUTH	INSTRUCT.	Ship	oard	Shore	based	Shipbo	oard	Shore	based
	\	3	λE	74	SN:	∨FR	IFR	VFR	IFR	∨FR	IFR	VFR	IFR
identity*					3	1+		1+		<u>_+_</u>		1+	
Inbound Heading*	1					1+		1+		1+		1+	
Base Recovery Course*					1	1+		1+		1		1	
Ship Course Ambiguity*					1	1+		1+		1		1	
Pattern Orientation*					1								
Pattern Dimensions*					1								
Relative Wind*					1				-				
Signal Delta/Charlie*					2	2-	1		1	2			
Range *					1	1		1		1-		1-	
Range Rate*					1	1		1		1-		1-	
Time-to-turn Milestone*					_1_	1+		1+		1		1_	
Lateral Tracking Error													
Approach Slope Tracking Error													
Range Milestone													
Obstacle Clearance													
Relative Altitude													
Longitudinal Haver Position									·				
Lateral Hover Position													
Hover Azimuth Error									'				
Deck Status													
Ship Motion													
Wave off													ļ
Horizontal Reference													
Hover Height													<u> </u>
Closure Rate Error													
Aircraft Flight Instruments				[-					<u> </u>	
Density Altitude]			2								<u> </u>

^{*} Excludes use of Electronic Aids

Not Visible - NV

Weak source -

** Visual signals are not currently used to provide this information

Strong source - + Moderate source - blank Very weak source - =

Figure 3-6. Summary of Information Required versus Information Provided for AV-8A - Homing, Orientation and Initial Approach Segments

the aircraft is 3 to 4 miles from touchdown at about 300 feet altitude. During Segment 4B – the close—in part of the final approach, the pilot is within approximately 1 mile of the site under VFR conditions and $1\frac{1}{2}$ miles of the site under IFR conditions. In either case, the pilot is focusing his attention on the site.

B. PILOT INFORMATION REQUIREMENTS

A review of the data contained in Figure 3-7 indicates the information required by the pilots surveyed for the initial and close-in portions of the final approach. In reviewing the percentages derived, it appears that there is substantial concurrence among all pilots in most of the information requirements. Pilots generally agreed that the following information was needed:

- 1. Base recovery course, inbound heading and relative wind, range milestone instructional data for task control and, in some cases, task limit warning.
- 2. Relative altitude and obstruction clearance for task limit warning and safety limit warning.
- 3. Vertical approach slope tracking error for determining rate of change and safety limit warning; and lateral tracking error for determining error magnitude and task limit warning.
 - 4. Closure rate error for determining task control error magnitude.
- 5. Horizontal reference cues for determining lateral and longitudinal task control error rate of change data.
- 6. Wave-off cues for determining instructional safety limit warning and deck status cues for determining instructional task control.

In reviewing the data further, it should be noted that:

- 1. Relative Wind The requirement for relative wind data is particularly critical in shipboard operations and is required again in this segment as an up-date to previously provided data.
- 2. Obstacle Clearance and Relative Altitude This data was of more concern to pilots operating from tactical sites due to the concern of contacting obstructions.
- 3. Harizontal Reference The requirement for harizontal reference cues was unanimously agreed by pilots but only in the close-in part of the final approach.

Instructional - Task Limit Warning Instructional - Task Limit Warning Instructional - Task Limit Warning Instructional - Task Control Instructional - Task Control Instructional - Task Control Instructional - Task Control Instructional - Task Control Instructional - Task Control Instructional - Task Limit Warning - Eughproach Slope Tracking Error Vertical - Safety Limit Warning - Vertical - Safety Limit Warning - Nertical - Safety Limit Warning - Instructional - Task Limit Warning - Instructional - Task Limit Warning - Instructional - Task Limit Warning - Instructional - Task Limit Warning - Instructional - Task Limit Warning - Instructional - Task Limit Warning - Instructional - Task Limit Warning - Instructional - Task Limit Warning	Iype Instructional - Task Limit Warning Instructional - Task Control Instructional - Task Limit Warning Instructional - Task Control Instructional - Task Control Lateral - Safety Limit Warning - Error Magnitude	Sea (Note 1) 20%/ 60%/ /80% 100%/60%	Shore (Note 2) 20%/
	rask Limit Warning sask Cantrol sask Limit Warning sask Cantrol sask Control Limit Warning - Error Magnitude	20%/ 60%/ 100%/60%	/%02
	ask Cantrol ask Limit Warning ask Control ask Control Limit Warning - Error Magnitude	%0%/~001 /%00	/%02
	ask Limit Warning lask Control losk Control Limit Warning - Error Magnitude	%0%/ 100%/60%	
	ask Control Task Control Limit Warning - Error Magnitude	%09/%001 100%/90%	
	lask Control Limit Warning - Error Magnitude	100%/90%	40%/100%
	Limit Warning - Error Magnitude	_	/%0*
	•		%52/
	Longitudinal - Satety Limit Warning - Error Magnitude		/25%
	Lateral - Task Limit Warning - Error Magnitude	100%/80%	%52 /%09
	Vertical - Safety Limit Warning - Error Magnitude	/%001	/%001
	Vertical - Safety Limit Warning - Error Rate of Change	%01/	%00L/
Instructional - Task	lask Limit Warning	40%/B0%	%05 /
	lask Control		/%09
Obstacle Clearance Instructional - Safe	Instructional - Safety Limit Warning	/20%	20%/25%
Relative Altitude Instructional - Task Limit Warning	fask Limit Warning	%02/	40%/
Instructional - Safe	Instructional - Safety Limit Warning		/20%
Deck Status Instructional - Task Control	lask Control	%09/%09	40%/75%
Wave-off Instructional - Task Control	lask Control	/%08	/%09
Instructional - Safe	Instructional - Safety Limit Warning	%00L/	%00L/
Horizontal Reference Lateral - Task Cont	Lateral - Task Control - Error Rate of Change	%001/	%00L/
Langitudinal - Task	Longitudinal - Task Control - Error Rate of Change	%00L/	%00L/
Closure Rate Error Longitudinal - Task	Longitudinal - Task Control - Error Magnitude	%09/%001	%05/%09

Note 2 - AV-8A Marines to Shore - Sample Size 5 pilots for segment 4A and 4 pilots for segment 4B (See Figure 6-18 series) Note 1 - AV-8A Marines to LPH/LHA - Sample Size 5 pilots (See Figure 6-17 series)

Segment 4A Segment 48

Figure 3-7. AV-8A Pilot Concurrence with Information Requirements - Final Approach Segment

C. EVALUATION CRITERIA

The site scene (centerline lights, drop-line lights and overhead floodlights, perimeter/edge lights and marking for ships) were not rated individually because data was not collected in sufficient detail to evaluate the cues provided by individual aids except in a general sense.

The precision approach radar is recommended for shooting approaches in conditions not less than $\frac{1}{2}$ mile visibility and 200 foot ceiling (1 mile and 300 for the AV-8A). The non-precision approach radar is not recommended in ceilings less than 400 feet and $1\frac{1}{2}$ miles visibility. The TACAN, ASR and ADF were not rated in Figures 3-8 and 3-9 individually as providing any source of data during the close-in portion of the final approach. In addition, it should be noted that the precision approach radar does not in itself provide required closure rate information because closure rate has to be computed by measuring the current speed and distance the aircraft is from the ship and comparing that with the desired numbers.

D. EVALUATION OF EXISTING SOURCES

The 6 basic sources of information evaluated in the initial and close-in portions of the final approach are rated in Figures 3-8 and 3-9, respectively, and discussed below:

- 1. Electronic Aids including TACAN, radar and voice communications are rated as a strong source in providing all required information.
- 2. Rotary Beacon Signal System and Wave-Off Lights the existing rotary beacon signal system and GSI wave-off lights provide a moderate source of deck status and wave-off information at night during the initial final approach with VFR minimums. As the pilot closes to the ship and commences the close-in portion, the lights become a strong source for deck status and wave-off information.

During day VFR conditions, it is questionable as to whether or not the lights can be readily seen during the initial final approach, although they were rated as moderate to weak sources during close-in portion of the approach.

During IFR conditions, the lights are barely visible at night during the initial portion of the final approach, but were rated as strong source during the close-in portion of the approach.

- 3. Wind Cone Movements in the wind cone installed at tactical sites are hardly visible during the initial final approach and only provide a weak source of data during close-in portion whether during the day or at night. Even when the wind cone is visible, it is difficult to judge the amount of air flow. In addition, it provides an unreliable source of wind direction except when the pilot can view the wind cone from above at a close distance.
- 4. View of the Ship/Field The view of the ship flight deck/island and the field during the day and VLA lighting in relation to ship navigational lights at night, provide only marginal visual cues with regard to range milestone, lateral tracking error, approach

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	īN			SMI		DAY	NIGHT	DAY	NIGHT	ě	THOM	DAV	THGH1
Relative Wind (Rotential Up-date)	7	+	\downarrow	3	Voice Communications	÷	÷	+	÷	1	÷	±	÷
	7	_	4										
Lateral Tracking Error	78	+	$ \downarrow $		Navigational Aids	÷	÷	÷	÷	÷	÷	÷	÷
	7	\dashv	\downarrow		Centerline/DropLine Lights	١٨-	4	¥	Ž	IA-	۷.	ž	ž
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	4	+	\Box		View of Ship/Field	IA-	1A=	¥ Z	ž	14	-¥1	ž	Ž
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Bonge Milestone	7	\dashv	\Box	2	View of Ship/Field	-	-	¥	¥	+1	1	¥	¥Z
		-											
Obstacle Cleanance (Shore)	\exists	\dashv	\Box	6	View of Obstacles	٧	₹	₹	ž		ž	2	¥Z
	_	\dashv	\Box										
Dack Status	7	\dashv	\Box	-	Rotary Beacon Signal System	Ξ1	-	¥	ž	¥	ž	ž	ž
	7	+	\Box	_	Voice Communications	÷	÷	÷	1+	÷	÷	÷	÷
	\dashv	+	\Box										
Wave-Off	7	+	1	-	Voice Communications	-	÷	÷	٤	÷	-	+	±
	4	+	\Box	_	Rotary Beacon Signal System	<u>"</u>	-	ž	ž			ž	ž
	7	+	\Box	_	GSI Wave-Off	Ľ	-	¥ Z	ž			ž	¥
	1	\dashv	\Box										
Clasure Atte Error	7	=	\prod	1	Navigational Aids	ž	₹	4	4	¥	ž	٧	4
	7	+	\rfloor	1	View of Ship/Field	₹	-¥-	ž	ž	¥	*	¥	₹ Z
	_	\dashv	\Box	_									
	\dashv	+	\Box	7									-
	\exists	\dashv	\Box	J									

Applicable (NA); Not Visible (NV); strong source (+); weak source (-); very weak source (=); moderate source (blank)

Figure 3-8. Evaluation of Existing Information Sources for AV-8A - Initial Final Approach Segment

REGINNEAMENT	П	П							EVAL	EVALUATION			
	_[LEWEL/TR	E	<u>ا</u> پ					LEVE	LEVEL/TYPE			
PREGMANATION .		0.2			X-denoted in		SHIP	SHPBOARD			SHOW	SHOREBASED	
	ERAL	8/'91	TICA	NUTI		*	VFR		Œ	_	E¥.		E
	121	101	_		- Com	DAY	MIGHT	DAY	MGHT	À	THEORY	λ¥	INCH!
Base Recovery Course	$\overline{+}$	\exists	\dashv	7	Voice Communications	÷	÷	1+	1	÷	÷	÷	٤
	-		\dashv	-}									
Aplative Wind	34	1 X	7	1	Voice Communications	1,	1.	÷	٤	34:	34.	34:	1,7
34	Shrebeed	7	\dashv	-									
	Ē		-{	-									
Lateral Tracking Error	28	\exists	\dashv	+	View of Shig/Field	-91	1A-	162	Ξ,ΥΙ	1	_≤	٤	4
	\dashv	\exists	+	\dashv	PAR	ž	ž	28+	28+	¥	ž	å	28+
	4	7	+	+	Center Line/Drop Line Lights	ΰ	ū	ار- ا	ıc	IC-	5	స్త	2
	4	_	+	_	Line up Marking	2	ž	10	ž	1,0	2	۲	2
	\neg	_	-+	-	Line-up Marking Roadlighted	Ž	10-	¥.	10-	٧×	-21	2	ئِ
	4	_	\dashv	-									
Approach Slape Tracking Error	\dashv		밁	-	View of Ship/Field	-9-	-Y	-91	IAF	16	¥1	۵	-¥2
	\neg	<u></u>	\dashv	\dashv	PAR	ž	≱	28+	28+	ž	*2	-82	28+
	4]	\dashv	\dashv	GSI	*	2A+	77	2A+	7₹	2.4.	7.∀	2A+
	\dashv	_	+	-									
Ronge Milestone	\Box	_	+	~	View of Ship		-¥1	18=	14≈	18	١٨	غ	-¥1
	1	_	+	+	PAR	ž	ž	÷.	2+	¥	٧×	**	2,
	7	\pm	+	+	-								
Obstacle Clearance	7	1	+	-	View of Obstacles	ž	≸	Ž	2	-	ž	-	Ž
	4	_	ᆜ.	\dashv	Obstocles Lighted	ž	3	Ž	ž	Ž	-	2	-
	7	_	+	+									
Relative Attitude	1	+	+	2	3 View of Ship/Field	ž	~	2:	2	**	2	*	~
	\dashv	1	+	+	PAR	ž	3	5	2.	ž	ž	÷	24
	_	_	-+	4									
Deck Status	\Box	1	-	-	Rotary Beacon Signal System	-	<u> -</u>	<u>-</u>	÷	ž	ž	ž	ž
	\Box	7	\dashv	4	Voice Communications	÷	<u>-</u>	<u>-</u>	+	<u>+</u>	÷	+1	±
			\dashv	4	GSI Wove-Off	1	۵	_	+1	ž	Ź	2	ž
Not Applicable (NA): Not Visible (NV);	Short	strong murce (+	÷	weak :	source (-): very week source (=): moderate	source (blonk)	_						

applicable (PA): Net Vidble (NV); strong murcs (*); weak source (-); very weak source (=); moderate source (blank)

Figure 3-9. Evaluation of Existing Information Sources for AV-8A -Close-In Final Approach Segment

MEDIAMENT				H					EVALU	ATION			
		LEVEL/TYPE	۳						LEVEL	LEVEL/TYPE			-
		_					SHIPB	SHIPBOARD			SHORE	SHOREBASED	
	1 VW 3	V)U	HTUM	ONU.		*	WR		FF	N	#		Œ
			WZY	LSNI		DAY	MGHT	DAY	WGHT	DAY	THEM	DAY	THEM
Horizontel Beference	10 10	U			View of Ocean	ıc÷	1C-	10	tc	ž	¥	2	ž
					View of Land	Ž	¥	¥	ž	1C+	10	ΣI	10-
Closure Bise Error	=				PAR	١٧	1A	١٨	14	14	٧i	11	1
					View of Ship/Lond	91	IA-	16	IA-	18	-YI	16	IA-
Wave-Off				9	Voice Communications	3	3	3	3	3	3	3	3
					GSI Wave-Off	3	3+	3-	3+	ž	¥	¥N	Ž
					Rotary Beacon Signal System	3	3	3-	3+	ž	ž	Ź	¥
				_									
				-									
No Amiliophia (NA). Not Visible (NV):	strong source	_	- -	week so	+): weak source (-): very weak source (=): moderate source (blank)	source (blonk)							

applicable (NA); Not Visible (NV); strong source (+); weak source (-); very weak source (=); moderate source (blank)

Figure 3-9. Evaluation of Existing Information Sources for AV-8A - Close-In Final Approach Segment (continued)

slope tracking error and closure rate error. The pilot can compare the size of the ship and vertical and lateral position of the ship with respect to the aircraft's window although these cues provide more of a sense of error direction rather than error magnitude. This information comparison is, however, influenced significantly by the side slip and yaw of the aircraft. The source is generally not as good at night as it is during the day because fewer cues are provided. In addition, neither ship or field can be seen during certain IFR conditions while commencing the initial portion of the final approach. The view of the ship, however, provides a strong source during the close-in portion for ship motion assuming that some horizontal reference, such as the view of the ocean, is also within the field of view.

- 5. Landing Centerline Markings and Lights Landing centerline markings which are floodlit at night and centerline lights including extended line-up and drop-line lights provide a poor source for lateral tracking error during the initial final approach, but a moderate source as the aircraft closes on the ship during the close-in portion. The marking and lights provide only task control information since the pilot does not receive, as desired, a specific visual indication when the task limit is reached. The pilot does, however, readily see if he is to one side or the other of the slot and does receive some indication of error rate of change as adjustments are made.
- 6. Glide Slope Indicator Pilots indicated that they needed a task limit warning and error rate of change with regard to vertical approach slope tracking error. The glide slope indicator was evaluated as only providing task limit information since it fails to specifically indicate a warning such as a flashing light while low. In addition, the glide slope indicator was rated as only providing error direction information because error magnitude is not provided in a precise manner such as with a spectrum of red, green and amber light, to indicate when the aircraft is, for example, slightly below, moderately below, or extremely below the approach path. Some order of magnitude can be, however, perceived from the three sectors. In terms of visual perception of the glide slope indicator, it is a strong source during the initial final approach at night under VFR conditions but can barely be seen during day VFR and day or night IFR condition. During the close-in portion, the glide slope indicator is a strong source at night and a moderate source during the day under VFR conditions.

E. DEFICIENCY

A summary of the most highly rated visual sources contained in Figures 3-8 and 3-9 are listed in Figures 3-10 and 3-11, excluding any form of electronic aids.

1. Perception of Aids - Under IFR conditions, the existing aids are not visible during the initial final approach and only barely at the beginning of the close-in portion. Therefore, the pilot must either rely on electronic aids or, in the case of EMCON, attempt to fly within visual range of the ship using the triangle search pattern.

Under VFR conditions of 5 mile visibility, the pilot can perceive the aids relatively well during the day or at night.

Information Required									In	formati	on Prov	/ided	
	L	LEV	/EL/T	YPE						Con	dition		
		5			<u> </u>		D	ay			Ni	ight	
	LATERAL	LÜNG./SPD.	VERTICAL	AZIMUTH	INSTRUCT.	Shipl	oord		based	Shipb	oard	Shore	based
	IĀ.	3	VEF	MZII	SNI	VFR	IFR	VFR	IFR	∨FR	IFR	VFR	IFR
Identity													
Inbound Heading													
Base Recovery Course													
Ship Course Ambiguity													
Pattern Orientation													
Pattern Dimensions							-						
Relative Wind (Up-date)*					1								
Signal Delta/Charlie													
Range													
Range Rate													
Time-to-turn Milestone							_						
Lateral Tracking Error *	2B					1A	1	1A		1A		1A	
Approach Slope Tracking Error*			3B			1A-		1'A		2A+		2A+	
Range Milestone					2	1		1+		1-		1	
Obstacle Clearance					3	NA	NA	1-	1	NA	NA	NV	
Relative Altitude													
Longitudinal Hover Position													
Lateral Hover Position													
Hover Azimuth Error													
Deck Status *					1	1=	NA	NA	NA	1	NA	NA	NA
Ship Motion													!
Wave off*						1=	NA		NA	1	NA		NA
Horizontal Reference													
Hover Height													
Closure Rate Error *		1B				1A	NA	14+	NA	1A-	NA	lA_	NA.
Aircraft Flight Instruments													

^{*} Voice Communications/ Navigation Aids ratings not included

Not Visible - NV Weak source

Strong source - + Moderate source - blank

Very weak source

Figure 3-10. Summary of Information Required versus Information Provided for ÁV-8A - Initial Final Approach Segment

Information Required									In	formati	on Prov	ided	
		LE/	/EL/T	YPE							lition		
,		ج			T.		D	ay			Ni	ght	
	LATERAL	LÜNG./SPD.	VERTICAL	AZIMUTH	NSTRUCT.	Shipt	oord		based	Shipb			based
	IA1	NO.	VER	AZ!	.SNI	VFR	!FR	VFR	IFR	∨FR	IFR	VFR	!FR
Identity													
Inbound Heading													
Base Recovery Course*					1								
Ship Course Ambiguity													
Pattern Orientation													
Pattern Dimensions													
Relative Wind*		Shi	/Sh	ore/	1/3A								
Signal Delta/Charlie													
Range							_						
Range Rate													
Time-to-turn Milestone													
Lateral Tracking Error *	28					10	10	10	1C	ıc	1C	ıc	ıc
Approach Slope Tracking Error*			3C			2A	2A	2A	2A	2A+	2A+	2A+	2A+
Range Milestone*					2	1 B-	1 B=	18	18-	1A-	1A=	1A	1A-
Obstacle Clearance					3	NA	NA	1	1	NA	NA	1	1
Relative Altitude*		Shi	p/Sh	ore/	2/3	2+	2+	2+	2+	2	2	2	2
Longitudinal Hover Position													
Lateral Hover Position													
Hover Azimuth Error													
Deck Status*					1	1	1-	NA	NA	1+	1+	NA	NA
Ship Motion													
Wave off					3	3	3-			3+	3+		
Horizontal Reference	10	10				1C+	10	1C+	10	1C-	1C=	10	1C-
Hover Height													
Closure Rate Error		1 B				18	18	18	1 B	1A-	1A-	1A-	1A-
Aircraft Flight Instruments													
													i

^{*} Voice Communications/ Navigation Aids ratings not included

Not Visible - NV

Weak source - -

Strong source - +
Moderate source - blank

Very weak source - =

Figure 3-11. Summary of Information Required versus Information Provided for AV-8A - Close-In Final Approach

- 2. Range Milestone and Closure Rate Error Information is provided only by the view of the ship which is at best only satisfactory during the day and rated as a weak source at night. Without a good indication of distance from the ship, it is difficult to establish a range milestone and thus adjust closure rate.
- 3. <u>Lateral Tracking Error</u> The centerline markings during the day and floodlit markings at night along with the centerline lights fail to provide a task limit warning, although as the pilot closes on the ship, he is able to discern error rate of change.
- 4. Approach Slope Tracking Error and Relative Altitude The glide slope indicator provides approach slope tracking information but fails to provide a precise indication of error magnitude or indication of error rate of change. In addition, the current intensity provides that it can only be seen during night VFR conditions while the pilot is commencing the final approach. The view of the ship/field during the close-in portion of the final approach provides moderate to strong relative altitude cues, although pilots operating to fields indicated that safety limit warning data is needed.
- 5. Deck Status and Wave-Off Information is provided by two good sources, the rotary beacon signal system and GSI wave-off lights, although neither can be seen in IFR conditions except during the close-in portion of the final approach.
- 6. Horizon Reference Information The view of the horizon depends on meteorological conditions. During times of high visibility the view of the horizon provides a strong source, whereas during 7 miles visibility and less the horizon cannot be seen. The view of the ocean establishes, although, an artificial horizon at the extremities of the visibility. At night, the same effect may not be apparent due to the ceiling and light from the moon. It was generally concluded that during a day or night situation with $\frac{1}{2}$ mile visibility and less, the view of the ocean would be minimal. The view of the ship was not included as a source since it moves and only provides horizontal information in relationship to the ocean.
- 7. <u>Base Recovery Course and Relative Wind</u> The pilots also indicated the need to be apprised of any changes in base recovery course and relative wind. No aid or procedure has been developed for accomplishing this task visually.

PART III. HOVER AND VERTICAL LANDING

A. SCENARIO

The hover and vertical landing segments are defined as follows:

The hover segment begins once transition to hovering flight is undertaken, and includes translational flight to the point from which the vertical landing is begun. During this segment, flight is conducted primarily by visual reference to the point of intended landing. The edge of the forward site is crossed at approximately 50 feet altitude or above, although 100 feet altitude is recommended if the pad is on loose surface to reduce the possibility of a dust cloud impairing the pilot's view. For shipboard operations, the pilot flies

to a position abeam, or slightly aft of abeam, the landing spot and translates across the deck edge at 25 feet above the deck and zero rate of descent. The pilot must continue to keep the nose of the aircraft into the wind and at night should not land with a heading of more than 30° left of ship's heading to avoid possible loss of visual cues.

- The vertical landing segment commences with the aircraft in hover over the touchdown point, and includes the vertical descent, touchdown and any recovery-assist and aircraft securing operations.

B. PILOT INFORMATION REQUIREMENTS

A review of the data contained in Figure 3-12 indicates the percentage of pilots which agreed with the information requirements and ratings suggested in the survey. In reviewing the percentages derived, it appears that there is substantial agreement with regard to the need for:

- 1. Relative wind
- 2. Deck status and wave-off for the hover segment only
- 3. Ship motion
- 4. Obstacle clearance
- 5. Lateral tracking error, relative altitude and closure rate during the hover segment
- 6. Longitudinal, lateral and azimuth hover error and hover height during the hover and vertical landing
- 7. Horizontal reference

A significant point, with regard to the above information, is the tendency on the part of the pilots to require practically the same information for hover and vertical landing except to a greater degree. Where, for example, pilots indicated a need for task control information during the hover segment, they would indicate a need for task control warning or, even, safety limit warning for the vertical landing segment. The pilots also indicated a similar preference in requesting error magnitude information during the hover segment but error rate of change or, even, change in error rate of change during the vertical landing segment.

Another observation should be noted regarding the need for deck status and wave-off information during only the hover segment. Pilots indicated that this type of data could not be used once the aircraft had been committed to descent.

C. EVALUATION CRITERIA

The pilot was considered totally visual during these segments and is largely dependent on either voice communications and the view of the ship, particularly, the island, or the view of the tactical site. In the case of the tactical site, it is difficult to generalize on the type of cues which might be available because of the differences in terrain.

		AV	-8A
Information Requirements	Туре	Sed (Note 1)	Shore (Note 2)
Relative Wind	Lateral - Safety Limit Warning - Error Magnitude Longitudinal - Safety Limit Warning - Error Magnitude Vertical - Safety Limit Warning - Error Magnitude Azimuth - Safety Limit Warning - Error Magnitude	100%/100% 100%/100% 100%/100% 100%/100%	100%/759 100%/759 100%/759 100%/759
Lateral Tracking Error	Lateral - Task Limit Warning - Error Rate of Change	100%/	100%/
Obstacle Clearance	Lateral - Safety Limit Warning - Task Limit Warning Longitudinal - Safety Limit Warning - Task Limit Warning Vertical - Safety Limit Warning - Task Limit Warning Azimuth - Safety Limit Warning - Task Limit Warning	100%/100% 100%/100% 100%/100% /100%	100%/759 100%/759 100%/759 /759
Relative Altitude	Vertical - Task Limit Warning - Error Rate of Change	100%/	100%/
Longitudinal Hover Position	Longitudinal – Task Limit Warning – Change in Error Rate of Change Longitudinal – Safety Limit Warning – Change in Error Rate of Change	100%/ /100%	100%/ /759
Lateral Hover Position	Lateral - Task Limit Warning - Change in Error Rate of Change Lateral - Safety Limit Warning - Change in Error Rate of Change	100%/ /100%	100%/ /759
Hover Azimuth Error	Azimuth - Task Control - Error Magnitude	100%/100%	100%/759
Deck Status	Instructional - Task Control	60%/	/
Ship Motlon	Lateral - Task Limit Warning - Error Rate of Change Lateral - Safety Limit Warning - Change in Error Rate of Change Longitudinal - Task Limit Warning - Error Rate of Change Longitudinal - Safety Limit Warning - Change in Error Rate of Change Vertical - Task Limit Warning - Error Rate of Change Vertical - Safety Limit Warning - Change in Error Rate of Change	100%/ /100% 100%/ /100% 100%/ /100%	75%/ /759 75%/ /759 75%/
Wav≠=off	Instructional - Safety Limit Warning	100%/	100%/
Horizontal Reference	Lateral - Task Control - Error Magnitude Longitudinal - Task Control - Error Magnitude Vertical - Task Control - Error Magnitude	100%/100% 100%/100% 100%/100%	100%/759 100%/759 100%/759
Hover Height	Vertical - Task Control - Error Rate of Change Vertical - Task Control - Change in Error Rate of Change	60%/ /75%	50%/ /759
Clasure Rate Error	Longitudinal - Task Limit Warning - Error Magnitude	60%/	75%/

Note 1 - AV-8A Marines to LPH/LHA - Sample Size 5 pilots (See Figure 6-17 series) Note 2 - AV-8A Marines to Share - Sample Size 4 pilots (See Figure 6-18 series)

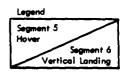


Figure 3-12. AV-8A Pilot Concurrence with Information Requirements -Hover and Vertical Landing Segments

It should also be noted that the problems associated with perceiving the cues in various meteorological conditions are nearly non-existent at this range. The sources were evaluated lower at night, however, due to the difficulties in perceiving contrasting and reference information.

D. EVALUATION OF EXISTING SOURCES

The eight basic sources of information considered essential in the hover and vertical landing segments are rated in Figure 3-13 and 3-14 and are discussed below:

- 1. Electronic Aids such as TACAN and radar were not rated during this final phase since these segments are essential visually even under the worst meteorological conditions.
- 2. View of the Ship/Field The view of the ship/field including the surfaces and markings during the day and the perimeter/edge lights and floodlit surfaces at night provides the pilot with information for judging relative altitude, hover height, longitudinal hover position error, lateral hover position error, hover azimuth error, closure rate and, in the case of ships, platform motion. The source can generally be thought of as strong during the day but considerably weaker at night.

Although the source itself is, as indicated, fairly strong from a visual standpoint, it generally only provides a task limit warning information since it does not provide the pilot with any type of specific warning when he is too high or low or to either side of the desired approach. In addition, the view generally provides an indication of error rate of change as the pilot maneuvers but not change in error rate of change.

The view of the ship/field decreases as the pilot transitions into the vertical landing segment.

- 3. View of Obstructions The view of obstacles provides a strong source during the day and a lesser source at night when the obstacles are floodlit with overhead lights. As the pilot completes the hover and commences the vertical landing he is unable to see the obstacles which he has cleared and focuses on any obstacles in front or on side of the aircraft, such as the island. The view of the obstacles appears to give the pilot an indication of task limit warning and even error rate of change, although pilots indicated that a safety limit warning was necessary.
- 4. Centerline Markings and Lights It should be noted that the cues received from these sources are adequate while approaching the ship but are not visible as the pilot hovers over the landing area.
- 5. Rotary Beacon Signal System provides a strong source of instructional information, although the pilot's attention is usually focusing on cues other than the rotary beacon.
- 6. Horizon and Sense of Horizon As discussed in the final approach segment, horizontal reference such as a view of the ocean is dependent on meteorological conditions. It

REGUMENENT									EVALUATION	ATION			
		LEVEL/TY	34						LEVEL/TYPE	/IVPE			
***************************************		-	_	_	•		SHIPBOARD	OARD			SHORE	SHOREBASED	
	TVV	LICVI	HLIN	DOM	SORCE	5	W.B		E.	*	WFR	-	##
		_	_	_		DAY	TNOW	AVO	THEM	DAY	THEM	DAY	MGHT
Relative Wind	38	38 38	38		Voice Communications	3	3	3	3	3	3	3	9
		_											
Lateral Tracking Error	20	Н	Ш		Center Line Marking or Lights	¥Z	Ž	NA	ž	2C+	2C+	2C+	2C+
		_			View of Ship and Island/Field	18	-91	18	- 9 1	18+	18	18+	2
			Щ		150	34	34	3A	3∧	ž	ΝΑ	ž	ž
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Oberacie Clearance	38 3	38 38	36		View of Obstacles	2C+	3C-	2C+	2C-	2C+	20-	2C+	3C-
		Щ			051	34+	3.A.+	3A+	3A+	¥	Y.	ž	Ž
		-	_										
Relative Altitude		30			View of Ship and Island/Field	28+	28	28+	28	28+	28+	28+	28+
	_	_			051	3∧+	34+	34+	3A+	ž	¥	ž	ž
		<u> </u>											
Longitudinal Nover Position		2D			View of Ship and bland/Field	3C+	20	2C+	20	Σ	×	32	20
		_	_		051	34+	3A+	34+	3A÷	ž	ž	ž	ž
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Loteral Hover Position	20	-			View of Ship and bland/Fleid	2C+	20	2C+	20	ŠČ	S S	2C+	ű
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Hover Azimuth Error		H	118		View of Ship and bland/Field	2C+	20	2C+	υ	3C÷	3C	2C+	ű
		-	Ц		OSI	34+	3A+	3A+	3A+	Ā	ž	ž	ž
		\vdash	_										
Deck Status		_	Ш	1	Voice Communications	=	÷	+	÷	÷	÷	÷	+
	Ι	_	Ц		Rotary Beacon Signal System	÷	÷	÷	÷	ž	₹	ž	ž
		\vdash											
Shie Mation	2C	2C 2C	J		View of Ship and Island	ıç	22	Ď	×	ž	ž	₹	ž
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of Applicable (NA); strang source (+); weak source (-); very weak source (=); moderate source (blank)

Figure 3-13. Evaluation of Existing Information Sources for AV-8A - Hover Segment

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		LEVEL/TYPE	<u>ڇ</u> [1					LEVEL	LEVEL/TYPE			
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	IVV3	2/.8l	(TUN	OURT	Source	5	WR	-	F.	\$	VFR		E
	_		_			DAY	MGHT	AVO	THEM	DAY	MGHT	DAY	THOM
Weve-Off			\bot	6	Voice Communications	3+	3+	3+	3	÷	÷	÷	÷
		4	\bot		Rotary Beacon Signal System	3+	3+	3+	3+	ž	¥Z	ž	ž
		-	_]										
Hover Height		2	$\prod_{i=1}^{n}$		View of Ship and bland/Field	10+	-51	-10-	ıc .	10+	10	10	5
			_]		150	1,4	٧ı	٧ı	₹	Ą	ž	2	ž
		-	\Box										
Closure Rate Error	7	28	_		View of Ship and bland/Reld	18	-¥1	91	-AI	18	4_	4	¥
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Not Applicable (NA); strong source (+); weak source (-); very weak source (=); moderate source (blank)

Figure 3-13. Evaluation of Existing Information Sources for AV-8A - Hover Segment (continued)

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19		_			TSMI		DAY	THOM	DAY	THOM	AVO	THOM	AVO	MIGHT
13 13 13 13 13 13 13 13	Relative Wind	38 36	ı	38		Voice Communications								
18 19 31 Streetwer Floodinghin 2C+ 2C 2C 2C 2C 2C 2C 2														
Sinch Live Floatilights 2C+ 2C 2C+ 2C 2C+ 2C 2C+ Obstacle Clearance	38 38		38		View of Obstacles	2C	3Č	20	2C	2C	2C	2C	20	
11 12 12 13 14 15 15 15 15 15 15 15						Structure Floodlights								
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20 20 20 20 20 30 View of Ship and bland/Field 2C+ 2C+	Lateral Hover Paition	8	\perp		\top	View of Ship and Island/Field	2C+	30	3C+	20	2C+	20	2C+	22
18 18 Wiew of Ship and blond/field 2C+ 2C 2C+ 2C 2C+ 2C 2C+ 2C 2C		#	+		T									
20 20 20 30 View of Ship 2C+ 2C 2C+ 2C NA NA NA NA NA NA NA NA NA NA NA NA NA	Hover Azimuth Error		4	=	_	View of Ship and bland/Field	ŞÇ.	20	2C+	3C	2C+	20	2C+	Si Si
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18 18 Horizon & Sense of Horizon 1C+ 1C- 1C- 1C+ 1C- 1C+ 1C- 1			4											
1D View of Ship and bland/Field 1C+ 1C- Horizontal Reference	18	<u>e</u>		7	Horizon & Sense of Horizon	JC+	ij	ن:	ICE	10:	2	ij	2	
1D View of Ship and bland/Field 1C+ 1C- 1C+ 1C- 1C+ 1C- 1C+ 1C- 1C+ 1C- 1C+ 1C- 1C+ 1C- 1C+ 1C- 1C+ 1C- 1C+ 1C- 1C+ 1C- 1C+ 1C- 1C- 1C- 1C- 1C- 1C- 1C- 1C- 1C- 1C-			_											ļ
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Figure 3-14. Evaluation of Existing Information Sources for AV-8A - Vertical Landing Segment

should also be noted that pilots indicated that only error magnitude as opposed to error rate of change requested during the final approach was required. It is suspected that this difference in rating is somewhat erroneous in that the pilot would like an indication of error rate of change but has, during the hover and vertical landing segments, started to concentrate solely on nearby objects. The view of the horizon was rated as a strong source during the day but a weak source at night, particularly under IFR conditions.

- 7. Wind Cone As indicated during the final approach segment, the wind cone is not a very accurate method of providing relative wind. It is difficult to observe small changes in the wind cone direction and extremely difficult, if not impossible, to sense wind speed. Furthermore, the view of the wind cone will most likely be obstructed from within the cockpit.
- 8. Landing Signal Officer The LSO is a primary source of information during day and night operations for the hover and landing segments. He is capable of providing lateral tracking error, obstacle clearance, relative altitude, longitudinal hover position error, lateral hover position error, hover azimuth error, deck status, wave-off and hover height information. The LSO can provide a task safety limit warning by indicating a wave-off if he thinks the pilot is too low or high, to the side, or close to an obstruction. In this sense, the LSO is an excellent source of data. The LSO is, however, limited to providing only error direction and, depending on the LSO, some sense of error magnitude.

E. DEFICIENCY

A summary of the most highly rated visual sources contained in Figure 3–13 and 3–14 are listed in Figure 3–15 and 3–16 for the hover and vertical land segments. The summary excludes electronic aids which could not be used under EMCON and LSO signals provided through voice communications as opposed to purely visual sources.

- 1. Perception of Aids Under either VFR or IFR conditions, the VLA are visible during the hover segment. Although the aids are visible from the standpoint of meteorological conditions, they are often obstructed during the vertical landing segment due to cockpit field of view.
- 2. Relative Wind Aside from voice communication, the only indication of relative wind comes from extraneous sources such as ocean swells or, in the case of tactical sites, tree movements. The sources are, therefore, poor under even favorable conditions. Furthermore, there is no reasonable visual indication of wind measurement even if ship or field meteorological equipment is employed. Wind measurement equipment is usually installed on the superstructure which does not always provide a reliable source of data for the condition which is occurring in the area of the aircraft. It is also questionable as to how a real time readout would help the pilot since he is likely to feel the effect at the controls about as quickly or even more quickly than the equipment could measure a sudden gust of wind.
- 3. Lateral Tracking Error, Relative Altitude and Closure Rate The view of the ship/ field provides a satisfactory source of lateral tracking error, except for providing a specific

Information Required							· · · · · · · · · · · · · · · · · · ·		In	formati	on Prov	/ided	
		LE	VEL/T	YPE							dition		
·		٦			<u> </u>		D	ay			N	ight	
	LATERAL	LÜNG./SPD.	VERTICAL	AZIMUTH	NSTRUCT.	Ship	board		based	Shipb			based
,	1	3	Æ	ξ	INS.	VFR	IFR	VFR	IFR	∨FR	IFR	VFR	!FR
Identity						1		<u> </u>					
Inbound Heading													
Base Recovery Course													
Ship Course Ambiguity													
Pattern Orientation													
Pattern Dimensions													
Relative Wind*	3B	3B	3B	ЗВ									
Signal Delta/Charlie													
Range													
Range Rate													
Time-to-turn Milestone													
Lateral Tracking Error	2C					1 B	18	2C+	2C+	1B-	1.B-	2C+	2C+
Approach Slope Tracking Error													
Range Milestone													
Obstacle Clearance	3 _B	ЗB	3 _B			2C+	2C+	2C+	2C+	2C-	2C-	2C-	2C-
Relative Altitude			3C			2B+	2B+	2B+	2B+	28	28	2B+	2B+
Longitudinal Hover Position		2D				2C+	2C+	2C	2C	2C	2C	2C	2C
Lateral Hover Position	2D					2C+	2C+	2C+	2C+	2C	2C	2C	2C
Hover Azimuth Error				1 B		2C+	2C+	2C+	2C+	2C	2C	2C	2C
Deck Status*					1	1+	1+	1+	1+	1+	1+	1+	1+
Ship Motion	2C	2C	2C			1C+	1C+	NA	NA	2C	2C	NA	NA
Wave off					3	3+	3+	NA	NA	3+	3+	NA	NA
Horizontal Reference	18	1 B	1 B			1C+	1C	1C+	10	1C-	1C=	10	1C-
Hover Height			10			1C+	1C-	1C+	10	1 C -	1C=	1Ç	1C-
Clasure Rate Error		28				18	1 B	1 B	1 B	1A-	1A-	1A	14-
Aircraft Flight Instruments													

^{*} Voice Communications/ LSO ratings not included

Not Visible - NV

Weak source - -

Strong source = + Moderate source = blank Very weak source - =

Figure 3-15. Summary of Information Required versus Information Provided for AV-8A - Hover Segment

Information Required						·			In	formati	on Prov	ided	
		LEV	VEL/T	YPE		<u> </u>			_	Cond	dition		
		Ö			1		D				Ni	ght	
	LATERAL	LÜNG./SPD.	VERTICAL	AZIMUTH	INSTRUCT	Ship	ooard	,	based	Shipbo	oard	Shore	based
,	Z	NOI	VER	AZII	SNI	∨FR	IFR	∨FR	IFR	∨FR	IFR	∨FR	!FR
Identity													
Inbound Heading													
Base Recovery Course													
Ship Course Ambiguity													
Pattern Orientation													
Pattern Dimensions													
Relative Wind*	3B	3в	Зв	3в									
Signal Delta/Charlie													
Range													
Range Rate													
Time-to-turn Milestone													
Lateral Tracking Error													
Approach Slope Tracking Error	L												
Range Milestone													
Obstacle Clearance	38	3 _B	3 _B	3 _B		2C	2C	2C	2C	2C	2C	2C	2C
Relative Altitude													
Longitudinal Hover Position		3D				2C+	2C+	2C+	2C+	2C	2C	2C	2C
Lateral Hover Position													
Hover Azimuth Error				1 B		2C+	2C+	2C+	2C+	2C	2C	2C	2C
Deck Status													
Ship Motion	2D	2D	2D			2C+	2C	2C+	2C	NA	NA	NA	NA
Wave off													
Horizontal Reference	1 B	18	18			1C+	1C-	1C+	10	1C-	1C=	10	1C-
Hover Height			10			1C+	1C+	1C+	1C+	1C-	IC-	1C-	IC-
Closure Rate Error													
Aircraft Flight Instruments													
						<u> </u>							<u>!</u>

* Voice Communications/ LSO ratings not included Not Visible

- NV

Weak source

Very weak source -

Strong source - + Moderate source - blank

Figure 3-16. Summary of Information Required versus Information Provided for AV-8A - Vertical Landing Segment

warning if the pilot strays too far to port or starboard of the desired path. As the pilot comes into a hover over the landing area, however, he loses site of most of the line-up display.

The view of the ship fails to provide the level of information desired by pilots with regard to both relative altitude and closure rate. The view of the ship/field is even less satisfactory at night.

- 4. Longitudinal Hover Position, Lateral Tracking Position, Hover Azimuth Error, and Hover Height The centerline markings and lights provide satisfactory hover azimuth error. However, the markings and lights only provide a sense of error rate of change as opposed to the change in error rate of change desired for lateral and longitudinal hover position. Consequently, the pilot must watch to see the error, wait to see the amount of change and watch to see the extent of change in rate of change. As a result of this situation it appears that a more instantaneous method is required. With regard to hover height, it appears that the level of information desired increases as the pilot moves into the vertical landing segment. The existing sources for hover height information only provide a degree of error rate of change.
- 5. Obstacle Clearance The view of obstacles themselves provides at best a task limit warning but not the desired safety limit warning. No device currently warns the pilot of an impending collision with an obstruction. It is assumed that as a part of the marking criteria that if the pilot hovers correctly he will not contact any obstacles.
- 6. Deck Status and Wave-Off It appears that the rotary beacon signal light and wave-off lights more than adequately provide the necessary instructional data to the pilot provided they are installed in a location where they can be readily observed.
- 7. Ship Motion and Horizontal Reference The view of the ship both during the day and at night does not provide the type of ship motion information needed, although ship motion on large aviation ships is not considered a significant problem. The horizontal reference provided by the ocean is a strong source during the day but becomes a weak source during the night and even a weaker source as meteorological conditions approach minimums. Additional horizontal reference information is, therefore, needed.

SECTION IV. CONCLUSIONS, PERFORMANCE REQUIREMENTS AND RECOMMENDATIONS

This section is divided into three parts. The first part provides the overall conclusions of the study and emphasizes the basic findings of the study. The second part identifies VLA performance requirements for homing/orientation/initial approach, final approach and hover/vertical landing. The requirements stem from the deficiencies resulting from the comparison of existing VLA sources versus information requirements. The third part discusses the recommendations of the study.

A. CONCLUSIONS

- 1. The methodology developed for classifying information requirements by the segments, levels and types of vertical, lateral, speed/longitude, azimuth data is workable.
- 2. Use of the methodology in surveying pilot information requirements tends to eliminate the subjectiveness and biases often found when the pilot is specifically questioned about the need for a particular device.
- 3. The type of operations conducted, number of flight hours logged and conditions under which the pilot experience had been gained proved to be an insignificant factor in survey responses.
- 4. There are only minor differences between the categories of information required for:
 - a. Helicopter operations versus AV-8 operations, including different types of helicopters.
 - b. Aviation ship operations versus air capable ship or tactical site operations.
 - c. Landing operations versus VERTREP, HIFR or SLED.
- 5. The differences in information required for particular aircraft, ship types or operations were reflected in the levels and types of data needed as opposed to the category of information (relative wind, ship motion, etc.) required.
- 6. The pilots surveyed often indicated the importance of the information by increasing the level and type of information desired.
- 7. The requirement to operate at NAVTOLAND minimums of zero ceiling and 700° visibility eliminates the need to conduct the homing, orientation, initial approach and final approach segments visually. The visual requirements for conducting normal VFR or IFR

operations are, in many cases, more stringent than the visual requirements for conducting low visibility operations.

B. PERFORMANCE REQUIREMENTS

1. Homing, Orientation and Initial Approach

- a. A homing device is needed with sufficient intensity to be seen in all VFR conditions and normal IFR. The device should also enable pilots to differentiate one ship from another.
- b. Develop a visual device, procedure (including pre-briefing) or combination thereof which will enable the pilot to receive basic approach and landing information under EMCON and emergency conditions.
- c. Develop a device or concentrate on methods of illuminating the ship which enables the pilot to properly position the aircraft with respect to altitude and the orientation and down wind leg of the initial approach.

2. Final Approach

- a. Develop a VLA device which provides both vertical and lateral tracking error information. The device should be visible for a 3 to 4 mile distance under normal VFR conditions and provide safety limit warnings when the pilot has strayed from the desired flight path. The device should be stabilized to the extent that operations are required (sea state 5 for NAVTOLAND) and provide a lateral and vertical beam spread commensurate with the desired flight envelope.
- b. Develop a VLA device or combination VLA device/tracking system which provides closure rate error information. The device or procedure should concentrate on providing the information when the aircraft is from 3 to 4 miles from the ship to the commencement of transition to hover.
- c. Review intensity capacities and beam spreads of deck status, wave-off, glide slope indicator, and line-up lights to determine the feasibility of making them visible during the commencement of the final approach.
- d. Develop a VLA device or procedure (including pre~flight briefing) which will effectively enable visual communication of instructional information such as relative wind and base recovery course while under EMCON or emergency conditions.

3. Haver and Vertical Landing

a. Develop a more meaningful VLA technique for measuring relative wind and providing the information to the pilot.

- b. Develop a VLA device which will enable the pilot to accurately determine actual position versus ideal position with respect to lateral, vertical and longitudinal displacement. Some form of warning should be incorporated to indicate the limits of the flight envelope. Special consideration should be given to helicopter VERTREP, HIFR and SLED operations requiring continuous hover and V/STOL operations requiring hover in aircraft with minimum stability.
- c. Provide a means of indicating to the pilot when he becomes dangerously close to an obstruction.
 - d. Develop increased horizon reference cues, particularly at night.

C. RECOMMENDATIONS

- 1. The VLA performance requirements identified herein should be used as a guide for defining and formulating the concepts needed to satisfy NAVTOLAND project goals and general VFR/IFR conditions for both helicopter and V/STOL aircraft. Of particular importance is information required for determining:
 - a. Identification of ship
 - b. Vertical and lateral tracking error.
 - c. Closure rate and range milestone
 - d. Hover position and horizon
- 2. The methodology and evaluation techniques developed as a result of this study should be used whenever new aircraft/site combinations are proposed. The approach should consist of:
- a. Developing a pilot information requirements matrix for the envisioned combinations.
- b. Evaluating existing lighting, marking and other visual cue sources to determine deficient areas.
 - c. Developing new VLA based on the deficient areas.
- 3. Further work in the area of information requirements should concentrate on determining:
- a. The effectiveness of individual VLA devices in providing visual cues to the pilot.
 - b. The efforts of VLA devices interacting in combination with each other.
 - c. The sensitivity requirements of the information identified by the pilots.

- d. The use of integration of VLA devices with landing guidance, tracking systems and aircraft displays.
 - e. The adequacy of intensity and beam spreads of existing lights.

SECTION V. TERMINOLOGY

The following terminology was developed and used as a basis for the survey.

A. INFORMATION LEVELS

There are three information levels, identified by the numbers 1, 2, 3 and $\overline{3}$, used to convey the opinion of how important an information requirement is and, in the same sense, the priority of the information. In addition, information levels are also intended to convey the consequences of not having the information.

- 1. Information Level 1. This is the level of information required for task control. An example of this type of information is the position of the "meatball" with respect to the datum arms of an optical landing system, such as the FLOLS. The displacement of the meatball indicates the direction and magnitude of the deviation from glide slope and the movement of the meatball indicates whether the aircraft is approaching or departing the glide slope and the speed with which this change is taking place. Information at Level 1 may also be purely instructive.
- 2. Information Level 2. This level of information indicates the limit of task control. It includes information of Level 1 and in addition includes a warning which says, "Do something or you will have to wave-off." An example of Level 2 information is the red color of the meatball of the FLOLS at the lower limit of its coverage.
- 3. <u>Information Level 3.</u> This level of information indicates a safety limit. It includes the information of Levels 1 and 2, and in addition includes a warning that the limits of safety are being approached and that something must be done immediately to avoid an accident. Thus, flashing the red, too-low meatball of the FLOLS if the aircraft were approaching the extreme lower limit of the signal would be information of Level 3.
- 4. <u>Information Level 3</u>. This level of information commands immediate action without explanation. It does not include information of Levels 1 and 2. Examples of information of Level 3 are the wave-off and cut signals of the FLOLS.

Information levels are also needed for "instructive" information. In this sense, the open-loop type of data that the pilot requires to make his approach to his destination should be considered from the viewpoint of the consequences of not having it. If the consequences of not having a particular bit of information is, in the opinion of the pilot, that he would not be able to perform the task at hand, but that there was no particular connotation of hazard to not being able to perform the task, that bit of information should be classed as Level 2. If, on the other hand, the absence of that particular piece of information would create a hazard, the information under consideration should be classified as Level 3. Information that is neither Level 2 or Level 3, is Level 1, because it relates only to task control.

B. TYPES OF INFORMATION

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There are four types of information designated by the letters A, B, C, and D. In dealing with errors, there is a point where there is no error, or where the error is within an acceptable tolerance. This is called the "error null."

- 1. Type A, Error Direction. Once the error goes beyond the null, the first bit of needed information is the direction of the error. Note that "Error Direction" conveys no "Magnitude" data. The information requirements have been termed in such a way as to reflect the various axes in which the pilots exerts control, so there is an error null with respect to distance or range, to speed, to the lateral track and to the vertical track. An example of the indication of an error null is the yellow on-glide slope indication of the GSI. The red LOW signal and the green HIGH signal indicate only direction of departure and are thus Type A information.
- 2. Type B, Error Magnitude. The next type of information that is required is that which tells how far from the null the aircraft has strayed in other words, "Error Magnitude." An example of this type of information is the displacement of the meatball of the FLOLS above or below the datum error. Note that Type B information also includes the error direction, Type A, information.
- 3. Type C, Error Rate of Change. If the trend of error magnitude were observed over a period of time, one could see the amount of error change within that time period; therefore, the rate of change of error changes. The perception of this rate of change would be greatest when the variation of magnitude is the greatest over the smallest period of time. It is this "Rate of Error Change" that makes up our Information Type "C". An example of this type of information is the movement of the meatball of the FLOLS. This type of information can also be indicated directly. For example, the vertical speed indicates rate of change of altitude.
- 4. Type D, Change in Error Rate of Change. To obtain a stable error null, it is necessary to have change error rate-of-change of information. This type of information is Type D information. The error magnitude, the rate-of-change of error, and the change of rate-of-change must be reduced to zero simultaneously in order to obtain a stable null.

At this point, it is appropriate to think of Error Types in terms of the practical experience in the hovering regime of flight. For example, assume that you are hovering over a point and note that you have started to drift to the right. You can see the approximate magnitude of your error, and the rate at which the error is accumulating. When you apply control to first stop the drift, and then move back over the hovering point, you perceive the change in the rate of change of that error through the point at which it becomes zero at the extreme of the deviation; then increases in the opposite direction until you are about over the hover point, at which time you again gradually change the error rate-of-change so that you can resume a stationary hover over the desired position.

Now assume that you are performing the same exercise in a black night in which you have no references except for those provided by your flight instruments. If you were asked what you needed at this point, you would all assume that your most desirable aid would be simply to floodlight the area so that you could see the hover point as you see it in daylight, but just suppose that such was not possible. Now what kind of information would you like to have?

C. INFORMATION REQUIREMENT ITEMS

The information requirements which are rated by levels and types are explained below. The numbers of the requirements listed correspond to the numbers used on the evaluation forms. Items i through n develop somewhat different procedures when applied to a racetrack approach pattern. Therefore, they are considered as applied to a straightin approach in part 1 of this paragraph and as a racetrack pattern in part 2.

1. Items for Straight-In Approach

- a. Identity
 - (1) Discriminate own vessel from empty field or from other ships
- b. Inbound Heading
 - (1) Determine compass heading to steer to overfly ship or to reach holding, Delta, marshall
 - (2) (Remember relative crosswinds over long distances)
- Base Recovery Course
 - (1) As distinguished from PIM, Fox Corpen or present course
- d. Ship Course Ambiguity
 - (1) Which end is which?
- e. Pattern Orientation Turning over ship/fix to gate, marshall, hold, etc.
 - (1) Know first heading after station passage or divert from inbound
 - (2) Heading for structured approach pattern, recognizing
 - other traffic
 - delays in Delta, holding
 - GRILS/LVA/HOBR monitoring
 - marginal IMC/VMC

- f. Pattern Dimensions
 - (1) Plan for pattern turns
- g. Relative Wind
 - (1) Relative navigation
 - (2) Crab/slideslip requirements on final approach
 - (3) Gross weight limits/single engine in hover
- h. Signal Delta/Charlie
 - (1) Clearance/delay time
- i. Range
 - (1) Distance from PIL before final approach
- . Range Rate
 - (1) Trend and rate of range before final approach
- k. Time-to-Turn Milestone
 - (1) Actual time for turns in structured approach
 - (2) Most critical on turn to final approach
- 1. Lateral Tracking Error
 - (1) Error to null
 - (2) Displaces heading requirement on final approach
- m. Approach Slope Tracking Error (include ø slope
 - (1) Error to null
 - (2) Vertical clearance factors
 - (3) Replaces altitude requirement on final approach
- n. Range Milestone (Final Approach)
 - (1) Closure rate adjustment
 - (2) Stimulate control functions (i.e., duct angles, reduce airspeed)

o. Closure Rate Error

- (1) Relative speed tolerance (null tolerance varies between pilots)
- (2) Narrowing tolerances with distance closure

p. Obstacle Clearance

- (1) Visual data prior to encountering physical carrier
 - (a) Remote from physical barrier, perhaps (i.e., painted outlines)

q. Relative Altitude

- (1) Altitude while outboard of ship structure (assures vertical clearance
- (2) Datum-cursor relationships per terrain or superstructure and horizon, etc.
- (3) Converts to hover height over ship or pad

r. Longitudinal Hover Position Error

- (1) In longitudinal approach, approach null
- (2) In lateral approach, maintain null
- (3) Station keeping prior to and during vertical landing

s. Lateral Hover Position Error

- (1) In lateral approaches, approach null
- (2) In longitudinal approach, maintain null
- (3) Station keeping prior to and during vertical landing

t. Hover Azimuth Error

(1) Visual aid in event of heading hold casualty

u. Deck Status

(1) If foxtrot 2-blocked, or green-light, deck in all respects safe and ready. FOD walk-down complete, LSE, fire suits, etc.

v. Ship Motion

(1) Potential for virtual horizon data

- (2) NATOPS/personal/special limits
 - (a) Recommendations to con
- (3) Null prediction
- w. Wave-off/cut (need additional item: cause)
 - (1) Advisory, precautionary or hazard
 - (2) Should include cause
 - (a) A/C conditions, procedures, deck/ship conditions
 - (3) Power calls
- x. Horizon Reference
 - (1) Pilot orientation (roll, pitch)
 - (2) Ship motion correlation (roll, pitch, heave, etc.)
- y. Hover Height
 - (1) Absolute vertical clearance dimension, consideration of both A/C and ship motion
 - (2) Control of vertical descent
 - (3) A/C over ship/pad
- z. A/C Flight Instruments All applications
- 2. Application to Racetrack Pattern (Items i n)

The items listed above are directly applicable to the straight-in approach. Some modifications in meaning are required to accommodate the "racetrack" pattern. These differences are discussed below.

- i. Range. This factor is adjusted to define the distances abeam, of the aircraft from the ship, while flying upwind for break, and on the downwind leg, preparatory to making the final approach turn at the 180 degree position.
 - j. Range Rate. This refers to the rate of change in range.
- k. <u>Time-To-Turn Milestone</u>. The positions for the turn to the downwind leg, and for the beginning of the final approach at the 180 degree position.
- 1. <u>Lateral Tracking Error</u>. Since there are no occasions in the racetrack approach within which the aircraft is tracking on a straight line toward the Point of Intended Landing (PIL), Lateral Tracking Error is a misnomer for application in the usual

NAVAL AIR ENGINEERING CENTER LAKEHURST NJ SHIP INSTAL--ETC F/8 1/2 STUDY OF PILOT VISUAL INFORMATION REQUIREMENTS FOR NAVY VERTICA--ETC(U) JUN 79 W S MITCHELL, C A DOUGLAS NI LEC-MISC-91-OR019 MI AD-A096 074 UNCLASSIFIED 2 of \$ 098074

sense. There is not a serious concern for lateral position until the last half of Segment Three, when the abeam range must be adjusted to assume a proper 180 degree position. The tracking task, itself, is a function of both "range," and "range rate," themselves purely instructive items since there is no feasible consideration of a closed-loop task in this segment.

For a given set of circumstances, described by the altitude and air speed of the helicopter, the relative wind, and the assigned LPH/LHA landing spot, there is but one position from which an approach can be flown with a constant, prescribed angle of bank, airspeed and rate of descent, to arrive at a prescribed point in space, on the projection of the 45 degree reference line of the landing spot. A pilot usually begins his approach as close to that point as he can, but in most instances finds that he must adjust his horizontal position by using continuous observations of progress toward the PIL, with a sense of lateral positioning with respect to the ideal path relative to his destination. In this sense, he performs "lateral tracking," using the integrated set of cues which emanate from his view of the landing site. It is the enhancement of this set of cue sources to which this information requirement is directed.

- m. Approach Slope Tracking Error. The slope aspect of a racetrack pattern is really a concern for flying level at an appropriate altitude on the downwind leg (Segment 3) and with a consistent rate of descent while turning in the final approach (Segment 4A and 4B) in a manner that should remove the hazard of inadvertently descending into the water. Since altitude data is extracted primarily from flight instruments on the downwind leg, and the shift is made to visual means, progressively, during the early part of Final Approach, the first concern for the visual acquisition of data is in Segment 4A, then continuing through Segment 4B. In order to remove the "straight-in" connotation to this term, the term itself is revised to "Vertical Tracking Error" in conformance to specific recommendations from interviewed Marine pilots.
- n. Range Milestone. Originally intended as the designation of a specific range at which functions such as check list items or airspeed changes were to occur, this is not in this style approach so much a function of range as it is a function of position. It is a "Functional Milestone," and the nomenclature is changed appropriately.

D. AXIS OF APPLICATION AND INSTRUCTIVE INFORMATION

Each approach segment is subdivided into categories of information termed "axis of application." This is done to ensure all flight parameters (lateral, vertical and speed/longitudinal) are covered within each segment of the approach. The term, "instructive", is provided to include general, informative data such as ship's course and speed, relative wind, etc.

SECTION VI. PILOT SURVEY OF INFORMATION REQUIREMENTS

This section provides the results of the pilot survey of information requirements. The information requirement categories and suggested ratings are indicated for each segment of the approach, along with the number of pilots which agreed or disagreed with the rating and any comments. Ratings which are circled indicate those that were suggested in the survey questionnaire, whereas ratings which are enclosed in a triangle were suggested by one or more pilots. Ratings enclosed in a square symbol were those considered to represent the actual requirement. The survey involved information requirements for the following aircraft and ship/shore combinations:

- 1. USN H-2 operating from Combatants, Figure 6-1 with 6 segments.
- 2. USN H-2 conducting HIFR Operations, Figure 6-2 with 1 segment.
- 3. USN H-46 conducting HIFR Operations, Figure 6-3 with 1 segment.
- 4. USN H-46 operating from Auxiliaries, Figure 6-4 with 6 segments.
- 5. USN H-46 operating from Combatants, Figure 6-5 with 6 segments.
- 6. USN H-53 operating from LPD's, Figure 6-6 with 6 segments.
- 7. USN H-53 conducting MK 105 SLED operations, Figure 6-7 with 2 segments.
- 8. USN H-53 conducting LPD MK 105 SLED operation, Figure 6-8 with 5 segments.
- 9. USN H-53 conducting MK 105 operations, Figure 6-9 with 5 segments.
- 10. MC UH-1/AH-1 operating from LPH/LHA's, Figure 6-10 with 6 segments.
- 11. MC H-46 operating from LPH/LHA's, Figure 6-11 with 6 segments.
- MC H-53 operating from LPH/LHA's, Figure 6-12 with 6 segments.
- 13. MC H-1/H-46/H-53 operating from LPH/LHA's, Figure 6-13 with 6 segments.
- 14. MC H-1/H-46/H-53 operating from Landing Zones, Figure 6-14 with 6 segments.
- 15. MC H-1/H-46/H-53 operating from Landing Zones, Figure 6-15 with 6 segments.
- 16. MC H-1/H-46/H-53 operating from Landing Zones, Figure 6-16 with 6 segments.
- 17. MC AV-8A operating from LPH/LHA's, Figure 6-17 with 6 segments.
- 18. MC AV-8A operating from Tactical Sites, Figure 6-18 with 6 segments.

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		C	Rating Suggested On Pilot Questionnaire Level		Type
)		1 - Jask Control 2 - Josk Limit Warning	8 - Error Magnitude
		4	A Rating Added By Pilot 2 - So	sfety Linit Worning	C - Error Rate-of-change
			Rating Provided In Evaluation Report		D - Chance in Errol Kale-Or Change
	FATINGS				
	1/2				No. Of Pilots:
¥ ¥	REQUIREMENT AND CATEGORIES CATEGORIES AS AS A SORE.	NO. OF PILOTS AGREE/DISAGREE	PILOT COMMENTS	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	ENGINEERING COMMENTS
1.	F		Vertical clearance identity essential. Most concerned with		
. ,	16/2		identity of getting on top of ship.		
1.			LN 66 used for this purpose. If BRC known - not necessary.		
1			Ship's course used to plan approach outbound.		
•			Orientation derived from ambiguity.		
1			Should be standardized.		
٥,			Must know prior to landing to ensure ship has provided envelope	ado	
J,				-	
•	A CONTROL OF THE PROPERTY OF T		Fuel considerations - BINGO. Are you clear for approach.		
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=	lime-10-1un Miletrone			\ \ \	
2	Lateral Trocking Error				
2	Approach Slope fracking than				
3	Range Milestone				
15	Obstacle Clearance				
92	Relative Alfitude				
17	_				
9	Н				
5	Hover Azimuth Error		the securions during this phase.		
8	Deck Stotus		-	(1.) 5, Lovel #1 Instructive	structive _
2	Ship Motion	3		1, Level #1A Speed Long"	Speed Long'l.
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2	+				
22	Closure Rate Error		The second secon		
8	Aircraft Flight Instruments (10) (18) 10		Por information only.		
1~	Special Info. Reg'd. Cat.				
2	Η-				
æ	VERTIEF Load Data				
8	_				
8	_				
គ	Skew/Tension Indications				
33	_				

Figure 6-1-1. USN H-2 Survey of Pilot Information Requirements - Operating from Combatants, Segment 1 - Homing

					Definitions		
				Rating Suggested On Pilat Questionnaire	Level	Туре	
				Roting Added 8v Dilot	1 - Task Control 2 - Task Timit Wassing	A · Error Direction	
			_		3 - Safety Limit Worning	6 * Error Magnitude C * Error Rate-of-chanse	
				Rating Provided In Evaluation Report		D - Chance in Error Rate-Of-Change	
		RATINGS	16s — 1				٦.
l	Busy	1114	en jion			No. Of Pilots: 19	
Ē	CATEGORIES SE SE SE SE SE SE SE SE SE SE SE SE S	! ?	AGREE/DISAGREE	PILOT COMMENTS		ENGINEERING COMMENTS	
-	Identity	\leq	-/1				
~	Inbound Heading	L					
m	Base Recovery Course	Ξ	15/4	First thing to determine. Not needed, Base recovery course	ry course		
7		2	12/7	enough. Essential from overhead out.			
اء	\vdash	0		·Standard.			
۰	\dashv	0	16/3	·Skandard.			
^	_	0		'Important for developing envelope.			
8	Signal Delta/Charlie	Θ	L.	'Must be expedited for fuel purposes.			
6	_	Θ	1/81				
2		Θ	17/2				
≈	Time-To-Turn Milestone	0	L	"Expeditious safety" is watchword.			
12	$\boldsymbol{\vdash}$	L					•
13	-	L					
7	Range Milestone						
12	Obstacle Clearance	_					
2	Relative Altitude	L				The state of the s	
17	Longitudinal Hover Position	_					
8	3 Lateral Hover Position	L					
61	Hover Azimuth Error						
ଯ	\dashv	Ξ	13/6	"If red deck, how long until green, Would attempt to obtain	to obtain		
5	Ship Motion	K)		prior to approach.			
22	2 Wave Off	Ц					
R	Horizontal Reference						
7	-	-					
22	Closure Rate Error	L					
%	S Aircraft Flight Instruments (IC) [16] [10]		0/61				
	.0.						
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R¦	-+	\dashv					
8	-	-					
8	-	-					
티	-	4					
33	Sled Status	\dashv				, s	

Figure 6-1-2. USN H-2 Survey of Pilot Information Requirements - Operating from Combatants, Segment 2 - Orientation

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						-		Definitions		
						<u> </u>	Rating Suggested On Pilot Questionnaire	Level	1ype	
						4	Reting Added By Pilot	1 - Task Cuntrol 2 - Task Limit Warning	A * Error Direction B * Error Magnitude	
							the state of the s	3 - Salety Limit Warning	C - Error Rote-of-change D - Chance in Error Rote-Of-Change	_
	•			3	MATINGS		Karing Frovidea in Evariants Report			_
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~	┢	L			H					
က	Base Recovery Course	H	Ц	Ĭ		12/7				
•	\vdash	-			V	1/-	5. Particularly at night important to be set up properly to avoid	y to avoid		_
2	Н	-			10	12/7	abrupt control of aircraft in segment 4 & 5.			
9	\vdash				0	15/4	6.·Standardized.			
^	Н				6		7. Proper flight envelope needed for planning purpose.			
8					0	13/3 (1.)		(1.) 3 Deletions		
٥	-	Н			Θ	15/4				
2	_	Н			Θ	15/4				
Ξ	_	_				14/5				
12	Н	H		Ħ	H					•
2	-	\dashv			H					
=	Range Milestone				ৰ	1/-				
2		\dashv			+					
2	S Relative Altitude	-			\dashv					
2	-	\dashv			-					
18	3 Lateral Hover Position				-					
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Figure 6-1-3. USN H-2 Survey of Pilot Information Requirements - Operating from Combatants, Segment 3 - Initial Approach

NAEC-MISC-91-OR019 A "Etroi Direction B "Etroi Magnitude C "Etroi Rote"of"change D "Chance in Erroi Rote"Of"Change ENGINEERING COMMENTS No. Of Pilots: (3.) 5, level #1, 2, 2, level #2 (2.) 1, Lovel #1 1, Lovel #2 (1.) 1, Level 11 Level 12 (4.) 2, Loval #1 I. level 12 Level 4 - Task Cantrol 2 - Task Limit Warning 3 - Safety Limit Warning Definitions PILOT COMMENTS What type winds, Proper envelope ensured, Rating Suggested On Pilot Questionnaire Rating Provided In Evaluation Report Begin to adjust for fast/slow closure. Clear to continue. Nice to know Rating Added By Pilot Not so critical in 4A. 4 AGREE/DISAGREE 9 €. 3/2/2 18/0 13/5 RAZINGS Hool bee 30 8 Fonge Rate
Time-To-Turn Milastone
Lateral Tracking Error
Approach Slape Tracking Error
Range Milastone
Obstacle Clearance
Relative Altitude
Longitudinal Haver Position 22 Wove Off
23 Horizontol Reference
24 Hover Height
25 Cloure Rate Error
26 Aircroff Flight Instruments
Special Info. Req'd. Cat. Skew/Tension Indications REQUIREMENT CATEGORIES Base Recovery Course Ship Course Ambiguity Pathern Orientation INFORMATION Pattern Dimensions Relative Wind Signal Delta/Charlie Hover Azimuth Error VERTREP Load Data Aircraft Separation HIFR Status Density Altitude Deck Status Ship Motion

Range

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13

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Figure 6-1-4A. USN H-2 Survey of Pilot Information Requirements -Operating from Combatants, Segment 4A - Final Initial Approach

Sled Status

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					_	Rating Suggested On Pilot Questionnaire Level		Type
) —			
					_	Ratios Added By Pilot 2 - Task Limit W.	control in:it Woming	A - Error Direction
					1		3 - Safety Limit Warning	6 - Error Rate-of-change
					_	Rating Provided In Evaluation Report		D - Chance in Error Rate-Of-Change
•			\$	MINGS				
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2 Inbound Heading	t	+	ļ	-				
3 Base Recovery Course	t	1	Ĭ	E	1/61	"Must have correct relative wind by this point. Should be known)wu	
├-		L		-				
5 Pattern Orientation		-						
6 Pattern Dimensions	_	L		H				
7 Relative Wind		L	Ĕ	Θ	14/6	Aircraft becoming slow & very susceptible to adverse wind en-		
8 Signal Delta/Charlie	L	\vdash	Ì	F	2/- (1.)	velope. Early warning necessary to correct aircraft heading.		
9 Range	_	_		-		Where are your winds? What will they do to me?		
10 Range Rate		_		-				
11 Time-To-Turn Mitestone	L	\vdash		\vdash			(1.) 2, Level #1 instructive	1 instructive
12 Lateral Tracking Error	(28	H			20/0	.O.K.	(2.) 5. Level #1	
13 Approach Slope Tracking Error		(39]]	_	20/0	Right!	2, Level #2D	/ 2D
Н	Ц	Ц	T	(2)	18/2			
15 Obstacle Clearance								
16 Relative Altitude		\vdash		-				
17 Longitudinal Hover Position	_	L		-				
18 Lateral Hover Position		\vdash	L	-				
19 Hover Azimuth Error	-	-		-			 	
┿		L		ε	15/5	"Wust begin to think of wave-off if ship not ready to recover		
21 Ship Motion	L	L		K	7/- (2.)	aircraft. Concerned with possible change in status. Unsafe to	0	
22 Wave Off		_		3	20/0	fly approach to unknown deck status from this point on.		
23 Horizontal Reference	N DI	ĮQ.		-	20/0	23. Visual on ship mandatory.		
† 		-	Ļ	-				
+-	_	2		-	13/7	*Compensate for fast closure, Approaching critical,		
+	2	IC TIB NO		+	1/61			
Special Info. Reg'd. Cat.	Ĺ							
27 Density Altitude		_		-				
28 VERTREP Load Doto		H		-				
-		\vdash						
30 HIFR Status		Н		\vdash				
31 Skew/Tension Indications		Н	<u> </u>					
32 Sled Status	_			-				

Figure 6-1-48. USN H-2 Survey of Pilot Information Requirements -Operating from Combatants, Segment 4B - Final Close-In Approach

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Signal Dalay Charitie Coll On the State	۰	Pottern Dimensions			
Signal Delta/Charles Signal Delta/Charles Concerned with wind; Vert not 3. Power and to produce the process of the proce	~	56 66 66 38	-	•Normally brief that optimum winds will be given in this situ-	
Range Rang	T.		ļ	ation or ship will talk to you for safety sake, usually not that	
Time-To-Turn Milestone Tonge Reta Time-To-Turn Milestone Tonge Reta Tonge Reta Tonge Reta Time-To-Turn Milestone Tonge Reta Time-To-Turn Milestone Tonge Reta Tonge Reta Tonge Reta Tonge Reta Tonge Reta Tonge Reta Tonge Retail Tracking Error Tonge Retail Tonge Tracking Error Tonge Retail	0	Parae		concerned with wind. Vert not 3. Power not a problem with	
Time-To-Turn Milestone 16/4 (2.) Ingraeo, This phase is critical since you are close in to land-dependent Stope Tracking Error 16/4 (2.) Ingraeo, This phase terminates in hover so it is a most critical depandent Stope Tracking Error 20/10 (3.) Milester in the administration of Closure rates. 20/20 (3.) Milester in the administration of Closure rates. 20/20 (3.) Milester in the administration of Closure rates. 20/20 (3.) Milester in the administration of Closure rates. 20/20 (3.) Milester in the administration of Closure Althode 20/20 (3.) Milester in the administration over after Closure Althode 20/20 (3.) Milester in the administration over after Closure Althode 20/20 (3.) Milester in the administration over after Closure Althode 20/20 (3.) Milester in the administration over after Closure Althode 20/20 (3.) Milester in the administration over after Closure Althode 20/20 (3.) Milester Internation of Closure Althode 20/20 (3.) Milester Internation of Closure Althode 20/20 (3.) Milester Internation of Closure Althode 20/20 (3.) Milester Internation of Closure Althode 20/20 (3.) Milester Internation of Closure Althode 20/20 (3.) Milester Internation of Closure Althode 20/20 (3.) Milester Internation of Closure Althode 20/20 (3.) Milester Internation of Closure Althode 20/20 (3.) Milester Internation of Milester Inter	وا	Ronos Rate		both engines functioning. Rate & rate change. Wave-off infor-	(1.) Vertical (only 13/7)
Lateral Tracking Error 20 16/4 (2, 1) ing area. This phose terminates in havers to it is a most critical Approach Stope Tracking Error 20/0 (3, 1) area regarding vehicle changes and clauser rates. Range Milestone 38 38 20/0 (3, 1) Where is the abstruction in relations to Accept the constitution of the constitution o	=	Time-To-Turn Milestone		mation for this phase is critical since you are close in to land-	(2.) 4, Level 13C
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Range Milestone Obstacle Clearance 39 39 30 20/0 (3.) Rebitive Alithude Longitudinal Hover Position 20 14/6 (4.) Vazimuth line-up essential in sofe operation over on Ff Class Langed Hover Position 20 15/5 (5.) Azimuth line-up essential in sofe operation over on Ff Class Langed Hover Position 20 20 15/5 (6.) Azimuth Error Deck Status Move Off Hover Height Hover Height Rebeits Alithude Wove Off Hover Height Instruments 20 70 20 (9.) Wove Off Hover Height Instruments 20 70 20 (9.) Wove Off Hover Height Instruments 20 70 70 (9.) Wove Off Hover Height Instruments 20 70 70 (9.) Wove Off Hover Height Closure Release Aircraft Flight Instruments 20 70 70 (9.) Wove Off Hover Height Closure Release Aircraft Flight Instruments 20 70 70 (9.) Wove Off Aircraft Flight Instruments 20 70 70 (9.) Wove Off Aircraft Flight Instruments 20 70 70 (9.) Wove Off Aircraft Flight Instruments 20 70 70 (9.) Wove Off Aircraft Flight Instruments 20 70 70 (9.) Wove Off Aircraft Flight Instruments 20 70 70 (9.) Wove Off Aircraft Flight Instruments 20 70 70 (9.) Wove Off Aircraft Flight Instruments 20 70 70 (9.) Aircraft Flight Instruments Aircraft Flight Instruments 20 70 70 (9.) Aircraft Flight Instruments Aircraft Flight Instruments Aircraft Flight Instruments Aircraft Flight Instruments Aircraft Flight Instruments Aircraft Flight Instruments Aircraft System Aircraft Syst	1 2	ing Fron	ļ	area regarding vehicle changes and closure rates.	(4.) 4, Level #3D
Obstacle Clearmee 38 38 39 14/6 (4.) . Where is the obstruction in relation to A/C heading over deck edge. 14/6 (4.) . Where is the obstruction in relation to A/C heading over deck edge. 14/6 (4.) . Where is the obstruction in relation to A/C heading over deck edge. 15/5 (5.) . Azimuth line—up essential in safe operation over on FF Class Lateral Hover Position 29 15/5 (6.) . Ship. Change made to reflect that sag 5 doesn't reminate until 15/5 (6.) . Ship. Change made to reflect that sag 5 doesn't reminate until 15/5 (6.) . Ship Motion 17/3 (7.) . Over touchdown spot. 17/3 (7.) . Over touchdown spot. 17/4 . Over touchdown spot. 17/4 . Over touchdown spot. 17/4 . Over touchdown spot. 18/4 . Over touchdown spot. 18	1	Proce Milestone			(5.) 5, Level *3D
Relative Altitude Lord Control of Control o		301 30			(6.) 3, Level "3D
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Hover Azimuth Eror (0) 17/3 (7.) over touchdown spot. Dect Status Dect Status 20 20 20 20 6.) Status must be known in order to either proceed to segment 6 or status should work of the control of	<u>a</u>	20		ship. Change made to reflect that seg 5 doesn't terminate until	(8.) 7, Level "2,
Deck Status Ship Motion Ship Motion Ship Motion Ship Motion Ship Motion Wove Off Hurizonel Reference 18 (18 (18 (18 (18 (19 (19 (19 (19 (19 (19 (19 (19 (19 (19	9	1	Į	over touchdown spot.	2, Level #3
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Horizontal Reference 18 (18 (18 173 (10.) "You are out of balance - imprimant for arientation. Hover Height Closure Rate Error Closure Rate Error Aircraft Flight Instruments 28 (1A) (28 19/1 (13.) The ship princraft must be sure that closure rate has been arrested and are sure and movement. Density Altitude Aircraft Separation HIR Status Staw/Tension Indications Staw/Tension Indications Staw/Tension Indications	3	1	9	If ship not ready to accept, aircraft must wave-off.	(11,) 3, Level #2C Vertical
Hover Height Closure Rate Error Aircraft Flight Instruments Aircraft Flight Instruments Density Altitude VERIRE Load Date HIS Sequ'Sents Secure Rate and Control movement. Sew/Tenion Indications Sew/Tenion Indications Sew/Tenion Indications Sew/Tenion Indications Sew/Tenion Indications	۶	A MAN MAN	2	You are out of balance - important for orientation.	(12.) 7, Level #38,
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	<u></u>	Skew/Tension Indications			
	32	Sled Status			

Figure 6–1–5. USN H–2 Survey of Pilot Information Requirements – Operating from Combatants, Segment 5 – Hover

NAEC-MISC-91-OR019

(1.) Resented on original matrix but not included in A Erra Direction
B * Erra Nagnitude
C * Erra Rate*of*change
D * Chance in Erra Rate*Of*Change ଥ ENGINEERING COMMENTS No. Of Pilots: pitot validation survey (2.) Same as above. l ybe tevel
1 - Task Control
2 - Task Limit Warning
3 - Safety Limit Warning "Items 17 & 18 concur Normally, brief that the optimum wind will be given in situation or ship will ralk to you for solery sake. Not that concerned with wind. See Segment 5. Some as tegment 5-38/ Power not a problem with both engines. Affacts hove stability. Concerned with motion for safety. Certain ship motion is beyond limits of ship & A/C pilon.

Critical with moving deck.

Ship poll/pitch can affect hover. Low or high information is required to mointain hover. Hover height is critical. Deck & orients one moving. Definitions "Don't have time to see change rate of change PILOT COMMENTS Rating Suggested On Pilot Questionnaire Rating Provided in Evaluation Report Rating Added By Pilot NO. OF PILOTS AGREE/DISAGREE 4 3 10/10 9/92 11/9 1/61 14/6 17/3 2 2 MATINGS 1,8001,901 1,8001,per क कि क (0) (0) (P) (P) 8 Range Rate
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Lateal Tracking Error
Approach Slope Tracking Error
Range Milastone
Charlocle Clearance
Relative Altitude 25 Closure Rote Error 26 Aircraft Flight Instruments Special Info. Req'd. Cat. 27 Density Altitude 28 VERTREP Load Data Longitudinal Hover Position Skew/Tension Indications INFORMATION REQUIREMENT CATEGORIES Inbound Heading
Base Recovery Course
Ship Course Ambiguity Lateral Hover Position Wave Off Horizontal Reference Signal Delta/Charlie Hover Azimuth Error Aircraft Separation Pattern Orientation Pattern Dimensions Relative Wind 20 Deck Status 21 Ship Motion Hover Height HIFR Status Slad Status Mentity 2 % 8 2 8 9 TEM

Figure 6-1-6. USN H-2 Survey of Pilot Information Requirements - Operating from Combatants, Segment 6 - Vertical Landing

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NAEC-MISC-91-OR019

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							<	Roting Added By Editor	1 - Task Control	A - Error Direction	
									3 - Safety Limit Warning	B - Error Magnitude	
								Rating Provided In Evaluation Report		D - Chance in Error Rate-Of-Change	
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17	Longitudinal Hover Position	E			\dashv	3/1 (2.)				1, Level 118 Azimuth	
9	Lateral Hover Position 30		Ц		\exists	3/1 (3.)			(5.) 3, L	3, Level 2 Lateral, Speed/Long'I. & Vertical	,
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Figure 6–2–1. USN H–2 Survey of Pilot Information Requirements – HIFR, Segment 5 – Hover

NAEC-MISC-91-OR019

A - Errur Direction
B - Errur Magnitude
C - Errur Rote-of-change
D - Chance in Errar Rote-Of-Change ENGINEERING COMMENTS (1.) Except for 2/1 Speed/Long'l. No. Of Pilots: 1 - Task Control 2 - Fask Limit Warning 3 - Safety Limit Warning Definitions level PILOT COMMENTS Rating Suggested On Pilot Questionnaire Rating Provided in Evaluation Report Rating Added By Pilot 4 3 AGREE/DISAGREE 22222 22222 ڄ en Hounes RATINGS <u></u> 1,8001/per 39 39 39 30 30 30 30 क् किया है। (3) (3) (3) क्ट घ्ट घट 93 9 ত্ন 11 Tine-To-Turn Milestone
12 Lateral Tracking Error
13 Approach Slope Tracking Error
14 Range Milestone
15 Obstacle Clearance Longitudinal Hover Position
Lateral Hover Position
Hover Azimuth Error
Deck Status (HIPR Status)
Ship Motion Aircraft Flight Instruments Sew/Tension Indications INFORMATION REQUIREMENT CATEGORIES Inbound Heading
Base Recovery Course
Ship Course Ambiguity Special Info. Reg'd. Cat.
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8 VERTREP Load Data Horizontal Reference Signal Delta/Charlie Pattern Orientation Aircraft Separation Pattern Dimensions Closure Rate Error Relative Altitude Relative Wind Hover Height HIFE Stotus Range Rate Sled Status Wave Off Identity Ronge 2 2 2 20 2

Figure 6-3-1. USN H-46 Survey of Pilot Information Requirements - HIFR, Segment 5 - Hover

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					_	Rating Provided In Evaluation Report		D - Chance in Error Rate-Of-Change
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	No.	79e->	12.0g	V/ZZ	AGREE/DISAGREE	PILOT COMMENTS	_	ENGINEERING COMMENTS
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Inbound Heading	<u>e</u>	-	L	L	L	fuel go-mo-go situation. Citical on long missions. Fuel	limit.	
Base Recovery Course		Н	Ц	Q	0/6	•Multi ship operations.		
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Definitions

Figure 6-4-1. USN H-46 Survey of Pilot Information Requirements - Operating from Auxiliaries, Segment 1 - Homing

N	AE	C.	-MI	SC-91-OR019
				PAGE VI-12

	٠				0 4	Rating Suggested On Pilot Questionnaire Rating Added By Pilot	Definitions Level 1 - Task Control 2 - Task Linit Warning 3 - Safety Linit Warning	Type A - Eno Direction B - Eno Magnitude C - Eno Rate-of-change
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اه	Pattern Dimensions	1	+	딕	1			
~]	Relative Wind	1	+		0%			
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Figure 6-4-2. USN H-46 Survey of Pilot Information Requirements - Operating from Auxiliaries, Segment 2 - Orientation

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INFORMATION REQUIREMENT CATEGORIES Identity Inhourd Heading Bene Recovery Course Ship Course Ambiguity Petrem Orientation Petrem Diseasion Renge Range Rate Range Rate Range Rate Range Rate Range Rate Range Rate Charles Fight Tracking Error Approach Sighe Tracking Error Approach Sighe Tracking Error Approach Sighe Tracking Error Approach Sighe Tracking Error Designal Delayore Pasition Lateral Hover Pasition Lateral Hover Pasition Lateral Hover Pasition Closure Rate Error Deck Street Aircraft Filight Instruments Ship Mosion Wave Off Horizonal Reference Hover Height Closure Rate Error Deck Street Aircraft Filight Instruments Petris Info. Red'd. Cat. Density Altitude VERTREP Load Data	behound Heading Bare Becovery Course Ship Course Ambiguity Pethem Orientorion Fethem Dimessions Relative Wind Signal Delty/Charite Range Rate Time-To-Turn Milestone Time-To-Turn Milestone Time-To-Turn Milestone Time-To-Turn Milestone Time-To-Turn Milestone Time-To-Turn Milestone Thereof Fracking Error Approach Slope Tracking Error Approach Slope Tracking Error Approach Slope Tracking Error Approach Slope Tracking Error Bange Milestone Charact Allende Laherd House Poblition Hove Off Hove Foldition Wove Off Hove Train Height Closure Rote Error Aircraft Flight Instruments pecial Info. Req'd. Car. Density Altitude VERIEEP Lood Data Aircraft Spanation Histore Spanation Histore Spanation Aircraft Spanation
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Definitions

Figure 6-4-3. USN H-46 Survey of Pilot Information Requirements - Operating from Auxiliaries, Segment 3 - Initial Approach

NAEC-MISC-91-OR019

						0	Rating Suggested On Pilot Questionnaire	level	lype	
						•		1 - Task Control	A - Error Direction	
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Definitions

Figure 6-4-4A. USN H-46 Survey of Pilot Information Requirements -Operating from Auxiliaries, Segment 4A - Final Initial Approach

NAEC-MISC-91-OR019

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						(Basing Constant On Pilot Questionnaire	973	100
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									D. Chance in Error Rate-Of-Change
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	INFORMATION			\ <u>`</u>	\ask \\ \s				No. Of Plich;
-		ং	S/1	N	STOLING OF PILOTS	JR Y	ativarian Co a Come		ENGINEERING COMMENTS
TEM		1	*	*	₹ 5	38.5	PILOI COMMENIS		
1-	Vibrail	+	╀	╀		\vdash			
-	Inbound Heading	-	+	H					
1	Base Recovery Course	-	-	$\mathbf{\Xi}$	0/8	-			
١	Ship Course Ambiguity		-	_		+			
ŀ	Pattern Orlentstlon	H	Н	Н		+			
ŀ	Pottern Dimensions		H	4		+			
 	Relative Wind	Н	Н	10		+			
8	Stanol Delta/Charite		Н	2	-/Z	1			
•	Ronge		Н	Ц		+			
2	+-			Н		+			
=	+-		-			+			
: 2	+-		Н	Н	9/8	1			
2	Approach Slape Tracking Error		90	\dashv	4	+			
=	╌	H	Н	2	%	+			
2	┿		٦	⋖	-/2	1			
2	┿~		1	2	4	+			
1	Longitudinal Hover Parilian		٦	4		1			
2	+-		+	\dashv		1			
=	├ ─		7	+	1	1		1 (0)	(1,) 1, Level 1 hatructive
8		1	7	Ŧ	3	+	Important at this point	1	1, Level 28 Instructive
2	Н	1	+	7	1	1		(2.) 6	(2.) Except for 7/1 Speed/Long'l.
Z	Wave Off]	†	4	078 E	+		(3.)	(3.) 1, Level 61
8	Horizontal Reference	<u> </u>	7	+	ove M	1			1, Level 12
~	Hover Height		7	+	-	ľ	Catalan final amounts to stille. Need to brow endy.	Some as 4A.	
2	Closure Rate Error	18	1	+		T	The state of notible.		
8	Aircraft Flight Instruments	വലതിയ	힑	\dashv	8/0 2	4	e Need as much special contract		
L	Special Info. Reg'd. Cat.			}					
2	Density Altitude		1	4		1			
15	-	7		4	-/2	=			
8	-	1	1	\dagger	+				
C.	\vdash	1	I	+	+	1			
5		1	1	†	+	T			
~	32 Slad Stotus	1		1					
1									

Figure 6-4-4B. USN H-46 Survey of Pilot Information Requirements – Operating from Auxiliaries, Segment 4B – Final Close-In Approach

NAEC-MISC-91-OR019
PAGE VI-16 A 'Error Direction B - Error Magnitude C - Error Rote-of-change D - Chance in Error Rate-Of-Change ۰ ENGINEERING COMMENTS (2,) Except for 8/1 Speed/Long'I.
and 7/2 Vertical No. Of Pitots: (1.) Except for 8/1 Azimuth 1 - Tosk Control 2 - Tosk Limit Warning 3 - Safety Limit Warning Definitions who fast must you initiate correction? Acceleration in alt. very critical here. 's clawe rate accelerated?

"Longitudinal just as important as lateral & vertical. Speed in close & transitions - VSI is still important part in hover & need "IRT VERTREP dash line requires little deviation in azimuth during hover. Landing too small or staged deck, vertical velocity information. Luse VSI constantly! PILOT COMMENTS Rating Suggested On Pilot Questionnaire Rating Provided In Evaluation Report Rating Added By Pilot 0 4 NO. OF PILOTS AGREE/DISAGREE 3 9 9.00 222222222 0/6 INDHUCITURE RATINGS HOUNTEN - 1, BUOT PER 0 50 (50 (50 (50) 2 8 8 8 20 20 20 æ Ø Range Rate
Time-To-Turn Milestone
Lateral Tracking Error
Approach Slope Tracking Error
Range Milestone
Obstocie Clearance Closure Rate Error
Aircraft Flight Instruments
Special Info. Reg'd. Cat. Longitudinal Hover Position INFORMATION REQUIREMENT CATEGORIES Sew/Tension Indications Base Recovery Course Ship Course Ambiguity Lateral Hover Position Signal Delta/Charlie Harizantal Reference Pattern Orientation Hover Azimuth Error Pattern Dimensions VERTREP Lood Data Aircraft Separation Inbound Heading Relative Attitude Density Altitude Relative Wind Deck Status Ship Mation Hover Height HIFR Status Wave Off Sled Status Identity

8

Figure 6-4-5. USN H-46 Survey of Pilot Information Requirements -Operating from Auxiliaries, Segment 5 - Hover

							Definitions		
					Ō	Rating Suggested On Pilot Questionnaire	Level	Type	
					△	Rating Added By Pilot	2 - Tosk Limit Warning 3 - Safety Limit Warning	8 - Error Magnitude C - Fron Rote of Shanse	
					Ċ	Rating Provided In Evaluation Report		D - Chance in Error Rate-Of-Change	
					i				
•		}	2	PATINGS					
			1	2/16	_			No. Of Pilots:	,
T	CATEGORIES		WIN	m	NO. OF PILOTS	PILOT COMMENTS	\ \ \	ENGINEERING COMMENTS	_
[]	CAIRCOMIES	\sim			AGREE/DISAGREE				
	Identity		Н						
2	Inbound Heading		Н	Ц					_
	Base Recovery Course		\dashv	4					_
	Ship Course Ambiguity		+	-					_
	Pathern Orientation		+	4					_
	ions		+	4					_
آ دا		딍	3	4	%				٠,-
	Signal Delta/Charite		+	\dashv					┯-
	\blacksquare	1	+	+					- م-
٦	_	1	+	4					ı.
11		\downarrow	+	+					-1
آ ہا	щ	1	+	+					r
~	-	1	+	+					; -
٠l	Ronge Milestone		-	+					
اما	-	5		+	0.)		(1.) Exce	Except for 8/1 Azimuth	
2	Relative Altitude	1	+	+	4			Except for 7/2 Smed/Long!	
늬	Longitudinal Hover Position		+	+	0%				r
إحما	-4	Í	-	+	0/4				ı
واحه	_	1	3	+	1/2	Same reasoning on Seg 3 nover Azimum.			; •
₹ ;	_	2.5	+	+	1/0				٠.
3 5	Waye Off		+	1					, -
le	Horizontal Reference	(8)	-	_	0/6				·i
7	+-	2		H	0/6				
22	┿	Ц		-					
وا	Aircraft Flight Instruments	H	\exists	\dashv					í
امرا	12								
3	Density Altitude			\dashv					r
爱	_		1	1					7 -
8		\rightrightarrows	1	1					اڪا ! "
8	-	1	1	+					ر- ا
뒤	-	1	+	+					14
32	Sled Status			4					1

Figure 6-4-6. USN H-46 Survey of Pilot Information Requirements -Operating from Auxiliaries, Segment 6 - Vertical Landing

							Definitions		_
					0	Rating Suggested On Pilot Questionnaire	Level	Туре	
				_	<	Rating Added By Pilot	1 - Task Control 2 - Task Limit Warning	A - Error Direction B - Fron Managhada	
					1		3 - Safety Limit Warning	C - Eror Rate-of-change	
						Rating Provided In Evaluation Report		D - Chance in Error Rate-Of-Change	
			MATINGS	NGS					7
		``		**************************************				No. Of Pilots:	
¥ .	CATEGORIES	ಌಀೢೢ	WIZE	AGREE/DISAGREE	GREE	PILOT COMMENTS		ENT STATE	
 -	identity	F		43		Becomes critical on long flights.			
2	Inbound Heading		-	2/0					_
6			0	2/۵					
•	Ship Course Ambiguity		2						_
~	Pattern Orientation				-	•Basic to relative wind.			_
۰	Pattern Dimensions		<u>e</u>						
^	Relative Wind		0		•	Becomes important when load limits air speed. Necessary for	ry for		<u> </u>
80	Signol Delta/Charlie		[2]			mission planning. Time required to satisfactorily act. Load	t, Load		
6	Ronge	Ц	Ω			related consideration. CRS attention. May require determin-	determin		_r
10	Range Rate		Θ	0/2		ation of loiter time vs. task. Depends on fuel state at start of	at start of		_
=	Time-To-Turn Milestone		L			approach.			
12	Lateral Tracking Error	H	Н						r -1
13	Approach Slape Tracking Error		\dashv						
<u>*</u>	Ronge Milestone		Н						-
15	Obstocle Clearance		H						
16	Relative Altitude		H				(1.) Exce	(1.) Except for 4/3 Lateral	<i></i>
13	Longitudinal Hover Position		_				•	5/2 Vertical	. ,
18	Lateral Hover Position						(2.) 4, 6	4, Level #1	- ,
19	1		H				1, Le	1, Level #2	- 1
8	\rightarrow		9	۷/۷					- +
5	Ship Motion		2	-/2					
22	Wave Off		Н						-,
23	Horizontal Reference		H						
7.	Hover Height		-						
52			\vdash						
2	ents		Н) 0/2	(1.)				· 1
*	Special Info. Reg'd. Cat.								
2	Density Altitude		Н						_
38	VERTREP Load Data		₹	5/-	(2.)	·Need to know for mission. Load weight limitations.			Ν
&	-	H	Ч						ΑI
8	-		\dashv						EC
핆	Skew/Tension Indications								- -
2	Sled Status	_	_						M
l	ł								,

Figure 6-5-1. USN H-46 Survey of Pilot Information Requirements - Operating from Combatants, Segment 1 - Homing

NAEC-MISC-91-OR019 A - Error Direction
B - Error Magnitude
C - Error Rate-of-change
D - Chance in Error Rate-Of-Change The VERTREP interface is not considered sufficiently different from other H-46 orientation segments. ENGINEERING COMMENTS No. Of Pilots: 1 - Tosk Control 2 - Tosk Limit Warning 3 - Safety Limit Warning Definitions CONTRACTOR OF COMMERCENCE AND ADDRESS OF THE PARTY OF THE PILOT COMMENTS Roting Suggested On Pilot Questionnaire Rating Provided In Evaluation Report A Rating Added By Pilot NO. OF PILOTS AGREE/DISAGREE RATINGS Lateral Tracking Error Approach Slope Tracking Error 14 Range Milestone
15 Obstacle Clearance
16 Relative Altitude
17 Longstudinal Hover Position VERTREP Load Data
Aircraft Separation
HIFR Solus
Stew/Tension Indications Aircraft Flight Instruments Time-To-Turn Milestone REQUIREMENT CATEGORIES Inbound Heading
Base Becovery Course
Ship Course Ambiguity INFORMATION Wave Off Horizontal Reference Hover Height Lateral Hover Position Special Info. Reg'd. Cat. Signal Delta/Charlie Hower Azimuth Error Pattern Orientation Pathern Dimensions Closure Rate Error 27 Density Altitude **Relative Wind** 21 Ship Molion 20 Deck Status Range Rate Sled Status Identity 8

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Figure 6-5-2. USN H-46 Survey of Pilot Information Requirements -Operating from Combatants, Segment 2 - Orientation

NAEC-MISC-91-OR019

			(Definitions	
			О -	Rating Suggested On Pilot Questionnaire	Level	Type
					1 - Task Control	A - Error Direction
			٥	Rating Added By Pilot	2 - Task Limit Warning	8 - Error Magnitude
					3 - Satety Limit Warning	C - Error Rate-of-change
				Rating Provided in Evaluation Report		D - Chance in Error Rate-Of-Change
•	. IM	MINGS				
	The second	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1				No. Of Plots:
TEM	CATEGORIES	N.West	NO. OF PILOTS AGREE/DISAGREE	PILOT COMMENTS	_	ENTS
-		 -	-/-			
2	Inbound Heading	-	-/2	Required to determine pattern to fly.		
3			9⁄9	Required for pattern orientation.		
4	Ship Course Ambiguity					
5		10	5/1	Plan pattern.		
6	Hons		0/9			
7		[0]	3/3	Plan Pattern. May require pattern adjustment. May determine	y determine	
	Delta/Charite	10	1/5	VERTREP final approach parameters.		
9		10	9/9			
2		0	وره			
11	2	Ð	6/0	May re required when adjusting pattern.		
12	Lateral Tracking Error	Н				
2	Approach Slope Tracking Error					
3		4				
2	Obstacle Clearance	2	3/-	External load increases clearance required.		
2	→		1/-			
7	Longitudinal Hover Position	_				
18	Lateral Hover Position	Ц				
19	Hover Azimuth Error	_				
8	Deck Status	D	0/9			
2	_					
\boldsymbol{z}	Wave Off	₩ W	1/-			
2	Horizontal Reference					
24	Hover Height	W)	1/-			
25	Closure Rate Error	۷I				
26	Aircraft Flight Instruments (CO Kig) (CO		9/0			
J	Special Info. Regid. Cat.					
n		Ц				
20		V				
8						
8	-				·	
ñ						
32	Sled Stelve	_				
l						

Figure 6-5-3. USN H-46 Survey of Pilot Information Requirements Operating from Combatants, Segment 3 - Initial Approach

NAEC-MISC-91-OR019 A - Error Direction
B - Error Avagnitude
C - Error Rate-of-change
D - Chance in Error Rate-Of-Change ENGINEERING COMMENTS No. Of Mote: 1 - Tosk Control 2 - Tosk Limit Warning 3 - Safety Limit Warning **Definitions** *External load is additional parameter. Need to know early if requirement exists. PILOT COMMENTS Determines type of approach or adjustment Weight for load to be picked up important. Rating Suggested On Pilot Questionnaire Need to know early if requirement exists. Rating Provided In Evaluation Report △ Rating Added By Pilot With or without load, NO. OF PILOTS AGREE/DISAGREE 222 \$ 2 2/2 8 1/9 MINGS Ξ (1) (1) (1) 38) 3 1 Time-To-Turn Misstone
2 Listeral Tracking Error
3 Approach Stope Tracking Error
1 Brage Milestone
5 Obstoc to Clearance
6 Relative Alifthude
7 Langihudinal Hover Position Weve Off
Horizontal Reference
Hover Height
Cloaure Rote Error
Africa Mile Hight Instruments Aircraft Separation
HIFE Status
Stew/Tension indications REQUIREMENT CATEGORIES Base Recovery Course Ship Course Ambiguity Pathern Ortenbation NFORMATION Lateral Hover Position Hover Azimuth Error Special Info. Reg'd. Cat. Belative Wind Signal Delta/Charite Pottern Dimensions VERTIEP Load Date 2 Density Altitude

TEM

Deck Status Ship Morton

z

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Sted Status

Figure 6-5-4A. USN H-46 Survey of Pilot Information Requirements -Operating from Combatants, Segment 4A - Final Initial Approach

				1	2014124	-	The second burns of the second	
	INFORMATION		1 ×		aniis S Kani			No. Of Moh: 7
TEM		800		22	2.	NO. OF PILOTS AGREE/DISAGREE	PILOT COMMENTS	ENGINEERING COMMENTS
-	Identity			7	V	-/1		
2	Inbound Needing	L		Η	L			
က	Base Becovery Course			۲	E	2/0		
•	Ship Course Ambiguity	F		-	L			
S	Puthern Orlentation	F		\vdash	L			
9	Pothern Dimensions	F		\vdash	L			
7	Belefive Wind	F		F	0	5/2	-Pattern or approach may need adjustment.	
•	Signal Delta/Charite	H		ř	V	-/2		
6	Range	L		\vdash	L			
9	Ronge Bote	F		\vdash				
Ξ	Time-To-Turn Milestone	L		H				
12	Lateral Tracking Error	10		H		۷/۵		
13	Approach Stope Tracking Error		Pg	-		۷/۵		
14	Range Milestone			7	<u> </u>	2/0		
15	Obstacle Clearance			7	1 22	3/-	External load an additional factor.	
16	Relative Altitude			И	M.	-/+	-VERTREP app. w/w/o load imposes another variable.	(1,) 3, level 13
17	Longitudinal Hover Position							3, Level #2
18	Lateral Hover Position	Н		Н				l, Level fil
61	Hover Azimuth Error			Н				
8	Deck Stotus		H	ÿ	3	(.)	"Would not want to stand off at night with a load, must know	
21	Ship Motion			4	<u> </u>	-/1	early. Deck status effects aircraft approach w/load.	
n	Wave Off			C	ାତ	2/4		
B	ference	(c) (c)		Н		2/0		
24	Hover Height			Н				
22	Closure Rate Error	(A)		Н		5/2	VERTREP load additional factor. Rate of closure in VERTREP	
8	ents		D)	Н		0/2	situation parameter.	
J	Special Info. Reg'd. Car.							
\boldsymbol{a}	Density Aliftude			Н	Ц			
8	_			7	- I K	-/2	Weight for load to be picked up is important,	
82	I	Ц						
8	_			Н				
8	Skew/Tension indications	7		\dashv	-			
32	Sied Status	_		_	_			
L				1				

Type
A - Error Direction
B - Error Magnitude
C - Error Role-of-change
D - Chance in Error Rate-Of-Change

Level 1 - Task Control 2 - Task Limit Warning 3 - Safety Limit Warning

Definitions

Rating Suggested On Pilot Questionnaire

Rating Provided In Evaluation Report

A Rating Added By Pilot

Figure 6-5-48. USN H-46 Survey of Pilot Information Requirements -Operating from Combatants, Segment 4B - Final Close-In Approach

Ĺ

NAEC-MISC-91-OR019 A - Error Direction
B - Error Magnitude
C - Error Rate-of-change
D - Chance in Error Rate-Of-Change ENGINEERING COMMENTS No. Of Mohi: 1 - Tosk Control 2 - Task Limit Warning 3 - Safety Limit Warning Definitions Level External load a factor. Closure rate paramount in VERTREP Ability to pick up load. Weight of load to be picked up essential PILOT COMMENTS Rating Suggested On Pilot Questionnaire VERTREP load additional consideration. Rating Provided In Evaluation Report -Important in picking up load. Depends on location of load, For pick up/drop, Rating Added By Pilot approach. 4 AGREE/DISAGREE NO. OF PILOTS **** 칳 5 22222 2222 3 Service Servic काक काक 2020 8 হ 20 10 Barge Bare
11 Time To-Turn Milestone
12 Laberal Tracking Error
13 Approach Stope Tracking Error
14 Barge Milestone
15 Obstocle Clearonce
16 Beletive Aliftbude 19 Hover Azimuth Error
20 Deck Stetus
21 Ship Motion
22 Wave Off
23 Horizontal Reference
24 Hover Height
25 Closure Rate Error
26 Aircraft Flight Instruments 17 Longitudinal Hover Position 18 Lateral Hover Position Skew/Tension Indications INFORMATION IEQUIREMENT CATEGORIES bround Heading
Base Becovery Course
Skip Course Ambliguity
Pathern Orlentation
Pathern Dissentions
Reletive Wind
Signal Delta/Cherite Special info. Regid. Cat.

Density Altitude

WENTEF Load Data

Referration Sled Status

Figure 6-5-5. USN H-46 Survey of Pilot Information Requirements -Operating from Combatants, Segment 5 - Hover

										Definitions			_
								0	Rating Suggested On Pilot Questionnaire	Level		Туре	
								<	Rating Added By Pilot 2	l - Iosk Control 2 - Iosk Limit Warning	rning	A - Errar Direction B - Errar Magnitude	
								}		3 - Safety Limit Warning	Varning	C - Error Rate-of-change	
								_	Rating Provided In Evaluation Report			D - Chance in Error Rate-Of-Change	
				_	Z TINGS	4 <u>6</u> 5						A CASE	7
	INFORMATION	`	_	(a)	/	1	7					7 1	
TE.	CATEGORIES	₹ ?	Speed Grayon		TW/27	SON THE	NO. OF PILOTS	13	PILOT COMMENTS	}		ENTS	1
1-	Identify	Ţ	×L	+	⇃		ORCE/ DISA GREE	#		1			T
•	Laboration of the contract	Ţ	\dagger	+	+	\downarrow		+					7
• -	But Personal	Ţ	1	+	+	\downarrow		+					7
•	Ship Course Ambiguity	Ţ	\pm	+	+	\downarrow		\dagger					Ţ
'n	Puttern Orlentation	I	t	╀	╀			\dagger		+			T
•	Pathern Dimensions	I	\dagger	+	\downarrow	1		Ť					T
-	Relative Wind	ē	100	19.	-	1	0/0	Т	and a second death formations and the second				Ţ
- ا	Sonol Delta/Charlie	_			1	-	2/2	T	wind across used important Wexternal toda, important to pick	nr to pick			T
۰l۰	The state of the s	Ţ	t	+	+	1		\dagger	up load.				Ţ
•	Konge]	1	+	4	1		+					7
의	Konge Kate	7	1	4	4	\downarrow							
=	Time-To-Turn Milestone		_	4	4			=	19. Tandem rotor consideration. Picking up loads near I line.	r I line.			- -
2	Lateral Tracking Error			Н		Ц		H	Must be directly over day line on some drop zones,	66.			
13	Approach Slope Tracking Error		۲	<u> </u>	L			۲					Γ
14	Ronge Milestone		ď	-	L	L		\vdash					Γ
13	Obstacle Clearance	38	12 (80)			L	9/0		·landem rotor & external load consideration. Depends on load	pool vo			[
2	Relative Altitude			-	L		1		location-drop location. Tandem rotar & external load con-	-woo poo	(l.) Except	Except for 8/- Arimuth	Γ
2	Longitudinal Hover Position	Ĺ	QQ	┝	L		5/4	\vdash	sideration.			Except for 7/2 Azimuth]
=	┿-	8		H	L		Ş	۲	Tondem rotor & external load consideration. Depends on load	pool no	3.) 3 lev	3. Level 3C Azimuth	Γ.
9	Hover Azimuth Error			CE CE	 	-	0%	Γ	location-drop location. Tandem rotor & external load con-	- pad con-	ł.	3. Level #18 Azimuth .	Γ
8	-	Ţ	\perp	+	₹		1	+	sideration.		1	1. Level 728 Azimuth	Ţ
~	Ship Motion	20	90	20	-	L	Ş	13	Martin will limit how low house can he for head un		l. lev	1. Level (3D Arimuth	
2	Wove Off		1	+	E		3/-				, Lev	1, Level P2D Azimuth	7- !
8	Horizontal Reference	Ē	U BU	9	_	L	2/2				(4.) 3. Level #2D	1 720	-
7	Hover Height		122	L R	Ł		9/0 (4.)	Τ	VERTREP load beight obove dack critical and we need accelera-	d occelera-	1	11/10	Τ
22	Closure Rate Error	F		╁	\vdash		1	Γ	tion and cues during approach. Flight instruments are moni-	are moni-	3. Level 3D	1/30	Γ.
2	Aircraft Flight Instruments	L		\vdash	L			H	tored by pilot not flying.		1, Level 83	1 13	Ī
1	Special Info. Reg'd. Cat.	L			-								Γ
8	Density Althride	F	L	F	F	L		-					<u>-</u>
R	VERTIEP Load Date	L	\vdash	+	Ŕ		3/-		elementary design food nick in betweeting info monitored - two	1 1,000			1
8	Alreroft Separation	F		+	+	-		1	load, watcht, size, shope & density.				14
8	HIFE Status	L	\vdash	\vdash	L	L		\mid					E
គ	Skew/Tension Indications	L	T	╀	L	L		+					C:
3	Sled Stotus	F	\vdash	╁	L			-					-^
1		1		#	#			1					AI T

Figure 6-5-6. USN H-46 Survey of Pilot Information Requirements -Operating from Combatants, Segment 6 - Vertical Landing

							Rating Suggested On Pilot Questionnaire	Definitions		
						ر		Level	Lype	
						٥	Rating Added by Pilot	2 - Tosk Limit Worning	A - Error Urrection B - Error Magnitude	
						Ĺ		3 - Salety Limit Warning	C - Error Rate-of-change	
						1	Koring Movided in Evaluation Report		D - Chance in Error Rate-Of-Change	
			K	5	702					ļ
	INFOIMATION REQUIREMENT	10,	aboy.		1/15	-			No. Of Pilots:	;
75.		*82/	\$\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	/m		NO. OF PILOTS AGREE/DISAGREE	PILOT COMMENTS		ENGINEERING COMMENTS	, -
Ŀ	Identity		L			9)
~		(3)		H		3/0				
7	Base Recovery Course	-		9		Q				1
1	Ship Course Ambiguity	7	7	3		ę				-
<u>1</u>	Pottern Offenditon	Ŧ	+	3		9/9				- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
上	Relative Wind	F	1	E		9.0				- -
0	Signal Delta/Charlie	F	1	E		9				
۵	Range	F	1			Q				i ···
2	Н					ę				
=	-			Н						ţ,
2	↤	H	H	Н						•
=	-			\vdash						i
=	-+	-		4						
<u>~</u>	-+	7	+	+						
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Figure 6-6-1. USN H-53 Survey of Pilot Information Requirements - Operating from LPD's, Segment 1 - Homing

NAEC-MISC-91-OR019 A - Error Direction
B - Error Magnitude
C - Error Rate-of-change
D - Chance in Error Rate-Of-Change ENGINEERING COMMENTS No. Of Plots: Level
1 - Task Control
2 - Task Limit Warning
3 - Safety Limit Warning **Definitions** PILOT COMMENTS Rating Suggested On Pilot Questionnaire Rating Provided In Evaluation Report Rating Added By Pilot 4 NO. OF PILOTS AGREE/DISAGREE 3,0 MINGS I GOOD POR Approach Slope Tracking Error 7 Longitudinal Hover Position
8 Lateral Hover Position
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24 Hover Height
25 Closure Rate Error
26 Aircraft Flight Instruments
Special Info. Req'd, Cat.
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Figure 6-6-2. USN H-53 Survey of Pilot Information Requirements -Operating from LPD's, Segment 2 - Orientation

NAEC-MISC-91-OR019 A - Error Direction
B - Error Magnitude
C - Error Rate-of-change
D - Chance in Error Rate-Of-Change ENGINEERING COMMENTS No. Of Pilots: 1 - Task Conrol 2 - Task Limit Warning 3 - Safety Limit Warning Definitions PILOT COMMENTS Rating Suggested On Pilot Questionnaire Rating Provided In Evaluation Report Rating Added By Pilot 4 NO. OF PILOTS AGREE/DISAGREE 2 8 333333 MINGS I BONIEN ज्यामध्य Range Rate
Time To Turn Milestone
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Special Info. Req'd. Cat. HIFE Status Skew/Tension Indications INFORMATION REQUIREMENT CATEGORIES Base Recovery Course SNp Course Ambiguity Pathern Orlenbations Density Altitude
VERTREP Load Data
Aircraft Separation Signal Delta/Charite Hover Azimuth Error Inbound Heading Relative Wind 20 Deck Status 21 Ship Motion Sled Status

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Figure 6-6-3. USN H-53 Survey of Pilot Information Requirements -Operating from LPD's, Segment 3 - Initial Approach

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NAEC-MISC-91-OR019
PAGE VI-28 A - Error Direction
B - Error Magnitude
C - Error Rate-of-change
D - Chance in Error Rate-Of-Change ENGINEERING COMMENTS No. Of Pilots: Level
1 - Task Control
2 - Task Limit Warning
3 - Safety Limit Warning Definitions PILOT COMMENTS Rating Suggested On Pilot Questionnaire Rating Provided in Evaluation Report Rating Added By Pilot 4 0 NO. OF PILOTS AGREE/DISAGREE 3,0 25 3,0 ટ્ટ క్లక్లి MATINGS Ronge

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21 Ship Motion
22 Wave Off
23 Horizontal Reference
24 Hover Height
25 Closure Rote Error
26 Aircraft Flight Instruments
Special Info, Req'd. Cat. 17 Longitudinal Hover Position 18 Lateral Hover Position INFORMATION REQUIREMENT CATEGORIES Base Recovery Course Ship Course Amblguity Pathern Orlenharion Pathern Dimensions Beletive Wind Signal Delta/Charlie 31 Stew/Tension Indications 27 Density Altitude
28 VERTREP Load Date
29 Aircraft Separation 19 Hover Azimuth Error inbound Heading Aircraft Separation 16 Relative Altitude 32 Shed Stotus 16.k

Figure 6-6-4A. USN H-53 Survey of Pilot Information Requirements -Operating from LPD's, Segment 4A - Final Initial Approach

NAEC-MISC-91-OR019 A - Error Direction
B - Error Nognitude
C - Error Rate-of-change
D - Chance in Error Rate-Of-Change ENGINEERING COMMENTS No. Of Pilots: 1 - Task Control 2 - Task Limit Warning 3 - Safety Limit Warning **Definitions** "Critical nase altitude. A/S of H-53 required definite warning of closure rate. H-53 weight makes speed change critical. Level (28) Speed critical, closure rate must be on. PILOT COMMENTS Rating Suggested On Pilot Questionnaire Rating Provided In Evaluation Report Might need rate info, as near ship. △ Rating Added By Pilot NO. OF PILOTS AGREE/DISAGREE કૂ ន្តន 25 228 8 ટ્ર 3 RATINGS ଡ Ε I BUT PER (C) COLOR 1) Time-To-Turn Milestone
12 Lateral Tracking Error
13 Approach Stope Tracking Error
14 Range Milestone
15 Obstacle Clearance
16 Relative Altitude Longitudinal Hover Position 26 Aircraft Flight Instruments Special Info. Reg'd. Cat. 27 Density Altitude Skew/Tension Indications INFORMATION REQUIREMENT 20 Deck Stelvs 21 Ship Motion 22 Wove Off 23 Horizontal Reference CATEGORIES Inbound Heading Base Recovery Course Ship Course Ambiguity 18 Lateral Hover Position Signal Delta/Charlie Aircraft Separation Hover Azimuth Error 28 VERTREP Load Data 29 Aircraft Separation Pattern Orlentation Closure Rate Error Relative Wind Hover Height Range Rate Sled Status

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Figure 6-6-4B. USN H-53 Survey of Pilot Information Requirements -Operating from LPD's, Segment 4B - Final Close-In Approach

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							٥	Rating Added by Pilot	2 - Jask Limit Warning 3 - Safety Limit Warning	5 - Error Rate-of-change	
								Rating Provided In Evaluation Report	•	D - Chance in Error Rate-Of-Change	
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2	Approach Slope Tracking Error	1	+	+	4	4					_
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Figure 6-6-5. USN H-53 Survey of Pilot Information Requirements -Operating from LPD's, Segment 5 - Hover

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Figure 6-6-6. USN H-53 Survey of Pilot Information Requirements - Operating from LPD's, Segment 6 - Vertical Landing

NAEC-MISG-91-OR019 A - Error Direction
B - Error Magnitude
C - Error Rate-of-change
D - Chance in Error Rate-Of-Change ENGINEERING COMMENTS No. Of Pilots: Level
1 - Task Control
2 - Task Limit Warning
3 - Safety Limit Warning Definitions PILOT COMMENTS Rating Suggested On Pilot Questionnaire Rating Provided In Evaluation Report Rating Added By Pilot 0 4 NO. OF PILOTS AGREE/DISAGREE 2 2222 22 2 2 2 MATINGS Sent per Ξ 6 6 6 छ Range Bate
10 Range Bate
11 Time-To-Turn Milestone
12 Lateral Tracking Error
13 Approach Stope Tracking Error
14 Bange Milestone
15 Obstacle Clearance
16 Beletive Alithude
16 Lateral Hover Position 9 Θ Longitudinal Hover Position Lateral Hover Position Hover Azimuth Error Deck Status Ship Motion 24 Hover Height
25 Closure Rate Error
26 Aircroff Flight Instruments
Special Info. Rey'd. Cat.
27 Density Altitude Skew/Tension Indications INFORMATION REQUIREMENT CATEGORIES Base Recovery Course Skip Course Ambiguity Pathem Orientation Pattern Dimensions Signal Delta/Charlie Harizontal Reference Aircraft Separation HIFR Status VERTREP Load Data Inboard Heading

Relative Wind

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Wave Off

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Figure 6-7-1. USN H-53 Survey of Pilot Information Requirements - MK 105 SLED, Hook-Up Maneuver A

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Figure 6-7-2. USN H-53 Survey of Pilot Information Requirements - MK 105 SLED, Hook-Up Maneuver B

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NAEC-MISC-91-OR019 A - Errar Direction
B - Errar Magnitude
C - Errar Rate-of-change
D - Chonce in Errar Rate-Of-Change ENGINEERING COMMENTS No. Of Pitots: Level
1 - Task Control
2 - Task Limit Warning
3 - Safety Limit Warning **Definitions** PILOT COMMENTS Rating Suggested On Pilot Questionnaire Rating Provided In Evaluation Report Rating Added By Pilot 4 0 NO. OF PILOTS AGREE/DISAGREE <u>ور</u> 222222 క్టక్ట MATINGS Ξ 66 999 J. Swol pas 50 [19][19] 9 9 Range Rote
Time-To-Turn Milestone
Lateral Tracking Error
Approach Slope Tracking Error
Range Milestone Relative Altitude
Longitudinal Hower Position
Lateral Hower Position
Hower Azimuth Error
Deck Stetus
Ship Motion Closure Rate Error Aircraft Flight Instruments pecial Info. Req'd. Cat. Skew/Tension Indications Inboard Heading
Base Recovery Course
Ship Course Ambiguity
Pathern Orientation INFORMATION REQUIREMENT CATEGORIES Density Altitude
VERTREP Load Data
Aircraft Separation
HIFR Status Horizontal Reference Signal Delta/Charlie Obstacle Clearance Relative Wind Hover Height Sled Status Wave Off Identity

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Figure 6-8-1. USN H-53 Survey of Pilot Information Requirements - Operating from LPD's and Towing MK 105 SLED, Segment 1 - Homing

NAEC-MISC-91-OR019 A - Error Direction
B - Error Magnitude
C - Error Rate-of-change
D - Chance in Error Rate-Of-Change ENGINEERING COMMENTS No. Of Priors: Level 1 - Task Control 2 - Task Limit Warning 3 - Safety Limit Warning De finitions PILOT COMMENTS Rating Suggested On Pilot Questionnaire Rating Provided in Evaluation Report Rating Added By Pilot NO. OF PILOTS AGREE/DISAGREE 0 4 25 2222 3/0 જ 2 MINGS रत्र तक राव ाठ। १८। १८ V 10 Ronge Rite
11 Time-To-Turn Milestone
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15 Obstocle Clearance
16 Relative Alithode
17 Longitudinal Hower Position
18 Longitudinal Hower Position
19 Hower Azimuth Error
20 Deck Status
21 Ship Motion
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26 Aircraft Right Instruments
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Figure 6-8-2. USN H-53 Survey of Pilot Information Requirements - Operating from LPD's and Towing MK 105 SLED, Segment 2 - Orientation

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Figure 6-8-3. USN H-53 Survey of Pilot Information Requirements - Operating from LPD's and Towing MK 105 SLED, Segment 3 - Initial Approach

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NAEC-MISC-91-OR019
PAGE VI-37 Type
A - Error Direction
B - Error Magnitude
C - Error Rate-of-change
D - Chonce in Error Rate-Of-Change ENGINEERING COMMENTS No. Of Miots: Level
1 - Task Control
2 - Task Limit Warning
3 - Safety Limit Warning Definitions PILOT COMMENTS Roting Suggested On Pilot Questionnaire Rating Provided In Evaluation Report A Roting Added By Pilot NO. OF PILOTS AGREE/DISAGREE ટ્ર 3/0 3 MINGS 30 I BOTTON 8 00 00 00 00 29 8 29 88 29 8 **62 63 63 e e** (38) (38) Q Range Bate
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Figure 6-8-4. USN H-53 Survey of Pilot Information Requirements - Operating from LPD's and Towing MK 105 SLED, Segment 4 - Hover

NAEC-MISC-91-OR019 A - Error Direction
B - Error Magnitude
C - Error Rate-of-change
D - Chance in Error Rate-Of-Change ENGINEERING COMMENTS No. Of Pilots: Level
1 - Task Control
2 - Task Limit Warning
3 - Safety Limit Warning Definitions PILOT COMMENTS Rating Suggested On Pilot Questionnaire Rating Provided in Evaluation Report Rating Added By Pilot 4 NO. OF PILOTS AGREE/DISAGREE 22 3,0 222 18 MATINGS Joshve V **a** 6 6 6 क्य क (D) (D) (D) e 90 Time-To-Turn Milestone
Lateral Tracking Error
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Bange Milestone
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Stew/Tension Indications 26 Aircraft Flight Instruments INFORMATION REQUIREMENT CATEGORIES Ship Course Ambiguity Pattern Orientation Pattern Dimensions Inbound Heading Base Recovery Course Special Info. Reg'd, Cat.

27 Density Altitude

28 VERTREP Load Data Wave Off Horizontal Reference Hover Height Closure Rate Error Lateral Hover Position Hover Azimuth Error Deck Status Ship Motion Relative Wind Signal Delta/Charlie Range Rate Sled Status 9

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Figure 6-8-5. USN H-53 Survey of Pilot Information Requirements - Operating from LPD's and Towing MK 105 SLED, Segment 5 - Vertical Landing

NAEC-MISC-91-OR019 A - Error Direction
8 - Error Magnitude
C - Error Rate-of-change
D - Chance in Error Rate-Of-Change ENGINEERING COMMENTS No. Of Pilon: 1 - Task Control 2 - Task Limit Warning 3 - Safety Limit Warning **Definitions** PILOT COMMENTS Rating Suggested On Pilot Questionnaire Rating Provided In Evaluation Report Rating Added By Pilot 4 NO. OF PILOTS AGREE/DISAGREE 22222 2 ٤ 2 2 Q, MINGS Ξ in any par त्वारवा त्व जिल्ला ज Range Rote
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Lateral Tracking Error
Approach Slope Tracking Error
Range Milestone
Obstocle Clearance Longitudinal Hover Position 26 Aircraft Flight Instruments Skew/Tension indications INFORMATION REQUIREMENT CATEGORIES Inbound Heading

Bose Becovery Course
Ship Course Ambiguity Special Info. Reg'd. Cat.

27 Density Altitude

28 VERTREP Load Data

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Figure 6-9-1. USN H-53 Survey of Pilot Information Requirements -MK 105 SLED Recovery, Segment 1 - Homing

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Figure 6-9-2. USN H-53 Survey of Pilot Information Requirements – MK 105 SLED Recovery, Segment 2 - Orientation

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Figure 6-9-3. USN H-53 Survey of Pilot Information Requirements - MK 105 SLED Recovery, Segment 3 - Initial Approach

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NAEC-MISC-91-OR019 Type
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B - Error Magnitude
C - Error Rate-of-change
D - Chance in Error Rate-Of-Change ENGINEERING COMMENTS No. Of Pilots: 1 - Tosk Control 2 - Tosk Limit Warning 3 - Safety Limit Warning Definitions Lovel PILOT COMMENTS Rating Suggested On Pilot Questionnaire Rating Provided In Evaluation Report △ Rating Added By Pilot NO. OF PILOTS AGREE/DISAGREE 2222 2 2 2 Θ 0 क कि कि कि व्यव्यव्य 9 8 00 00 20 13 Approach Stope Tracking Error 14 Bange Milestone 15 Cleator le Clearonce 3 16 Belotive Altitude 17 Longitudinal Hover Position Weve Off
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Figure 6-9-4. USN H-53 Survey of Pilot Information Requirements -MK 105 SLED Recovery, Segment 4 - Final Approach

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Figure 6-9-5. USN H-53 Survey of Pilot Information Requirements - MK 105 SLED Recovery, Segment 5 - Hover

NAEC-MISC-91-OR019 A - Error Direction
B - Error Magnitude
C - Error Rate-of-change
D - Chance in Error Rate-Of-Change ENGINEERING COMMENTS No. Of Pifots: Level
1 - Task Control
2 - Task Limit Warning
3 - Safety Limit Warning **Definitions** In case a larger ship or alternate is available. Nice to know for planning. Critical If operation at limits of range and EMCON. PILOT COMMENTS Rating Suggested On Pilot Questionnaire Rating Provided In Evaluation Report A Rating Added By Pilot Location NO. OF PILOTS AGREE/DISAGREE 26/0 28/0 MINGS Service Servic (C) (C) Approach Slope Trecking Error
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Figure 6-10-1. MC UH-1/AH-1 Survey of Pilot Information Requirements - Operating from LPH/LHA's, Segment 1 - Homing

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NAEC-MISC-91-OR019 A - Error Direction
B - Error Aognitude
C - Error Rate-of-change
D - Chance in Error Rate-Of-Change ENGINEERING COMMENTS No. Of Pilots Level 1 - Task Control 2 - Task Limit Warning 3 - Safety Limit Warning Definitions Determines flight pattern, turn to down wind, etc. PILOT COMMENTS Mong pattern cause wave-off & confusion. Rating Suggested On Pilot Questionnaire Fuel considerations will increase this.
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Figure 6-10-2. MC UH-1/AH-1 Survey of Pilot Information Requirements -Operating from LPH/LHA's, Segment 2 - Orientation

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Figure 6-10-3. MC UH-1/AH-1 Survey of Pilot Information Requirements - Operating from LPH/LHA's, Segment 3 - Initial Approach

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Figure 6-10-4A. MC UH-1/AH-1 Survey of Pilot Information Requirements - Operating from LPH/LHA's, Segment 4A - Final Initial Approach

				
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Figure 6-10-4B. MC UH-1/AH-1 Survey of Pilot Information Requirements - Operating from LPH/LHA's, Segment 4B - Final Close-In Approach

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6 Pathern Dimensions			Ц									П
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10 Range Rote			4									٦
11 Time-To-Turn Milestone												٦
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Definitions

Figure 6-10-5. MC UH-1/AH-1 Survey of Pilot Information Requirements - Operating from LPH/LHA's, Segment 5 - Hover

Figure 6-10-6. MC UH-1/AH-1 Survey of Pilot Information Requirements - Operating from LPH/LHA's, Segment 6 - Vertical Landing

NAEC-MISC-91-OR019 A - Error Direction
B - Error Magnitude
C - Error Rote-of-change
D - Chance in Error Rate-Of-Change 2 ENGINEERING COMMENTS No. Of Pilots: 1 - Task Control 2 - Task Limit Warning 3 - Safety Limit Warning **Definitions** ship. Must know feel or combor situation, Critical. Need to identify ship to follow heading. Primary consideration is the correct ship selection.

Occosionally, Several masshall points. Critical If you have Critical. We need instruction & a visual slope indicator on the Historied - estimate time deloy. Foul deak? Don't need while homing. Like to know. Level Nice to know. Critical if low fuel state or multiple flights. Critical due to fuel requits. PILOT COMMENTS Rating Suggested On Pilat Questionnaire Rating Provided In Evaluation Report If multi-olicial operations Rating Added By Pilot multiple flights. Nice to know. Alice to know. Nice to know C 4 NO. OF PILOTS AGREE/DISAGREE 222222 8 3 2 <u>[Ş</u> <u>1</u> RATINGS Annals **BEEGGEE** Θ I ROLLAN **१८ १८ ४८** ात कि कि 0 10 Range Rate
11 Time-To-Turn Milestone
12 Lateral Tracking Error
13 Approach Stope Tracking Error
14 Range Milestone 16 Belotive Altitude
17 Longitudinal Hover Position
18 Lateral Hover Position
19 Hover Azimuth Error
20 Deck Stehas
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26 Aircraft Flight Instruments
Special Info. Regid. Cat.
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Figure 6-11-1. MC H-46 Survey of Pilot Information Requirements -Operating from LPH/LHA's, Segment 1 - Homing

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PAGE VI-51

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Ing Error 19/0 19/0 19/0 19/0 19/0 19/0 19/0 19/0	5. Whong patterns cause wave offs & confusion.		
Ing Error (0) 19/0 19/0 19/0 19/0 19/0 19/0 19/0 19/0	6.•Safe areas - clear.		1
Ing Error Ing Error Addition 19,0 13,6 1,- 14,- 14,- 14,- 15,- 16,- 18,1 17,- 17,- 18,1 17,- 17,- 18,1 18,1 17,- 17,- 18,1	7. otherd to know/adjust pattern, deck status.		
ing Error althon 13/6 1/- 14- 16 (B) (G) 18/1 (Z) 18/1 (Z)	B. Critical if multiple flights. Other aircraft in Delta. What is		_
110g Error 12 (10) 13/6 1/- 1/- 1/- 13/6 13/6 13/6 13/6 13/6 13/6 13/6 13/6	recovery/separation of multiples/terrain clearance/critical		Ť
13/6 (1) 13/6 1/	for fuel req. Obstacle Info.		_,
17- 13/6 17- 17- 18/1 2. 18/1 2. 18/1 2.	9, Obstocle free.	l	_
12.6 (1) 13.	11,.2 vice I to prevent pattern over/up if more than I marshall	(1.) 1 Deletion	_
neition 13/6 1/2- rents 1/2 18/1 2. 3/2/24/2/2 3/4 1/2-	ored.	2, Level "28 Speed/Long"I.	_
13/6 1/2- 14- 1/2- 16- 18/1 2- 18/1 2			-,
13/6 1/2- 1/2- 1/2- 18/1 12.		(2.) Except for 1//2 Vertical	_
13.6 1.7- 1.7- 1.7- 1.8- 1.7- 1.8- 1.8- 1.8- 1.8- 1.8- 1.8- 1.8- 1.8			_
1/- 1/- 1/- 1/- 1/- 1/- 1/- 1/- 1/- 1/-	offer, time delay if fouled. Foul deck situation, if from I must break.		,
18/1 E.	Helps plan final,		-,
18/1			_
19/1			_
19 19 19 19 19 19 19 19 19 19 19 19 19 1			_
18/1 B/1 B/1 B/1 B/1 B/1 B/1 B/1 B/1 B/1 B			_
-/1 (A) (A) (A)	· Critical if multiple flights.		_
SAKAKA			
5्राइयहर्य (का			_
-/1 (A) (A) (A)			N.
	· Multi-aircraft operation.		AI
			EC
Skew/Tension Indications			:- <i> </i>
			M

Figure 6-11-2. MC H-46 Survey of Pilot Information Requirements - Operating from LPH/LHA's, Segment 2 - Orientation

			Defi	Definitions		
		0	Rating Suggested On Pilot Questionnaire Level		Туре	
		٥	1 - 1. Rating Added By Pilot 2 - 1.	1 - Iask Control 2 - Task Limit Warning	A - Error Direction B - Error Magnitude	
				alety Limit Warning	C - Error Rate-of-change	
			Rating Provided In Evaluation Report		D - Chance in Error Rate-Of-Change	onge
	SONITAG			And the Paris of State of Stat		
	100	7			No. Of Mioh:	<u>\$</u>
TEM	CATEGORIES CATEGORIES	NO. OF PILOTS AGREE/DISAGREE	PILOT COMMENTS		ENGINEERING COMMENTS	
i	identity					l
~	Inbound Heading					
	Base Becovery Course	1/4	Again for plan. Need for race track pattern. Accessory for	<u></u>		
+	Ship Course Ambiguity		fanding.			
5	Pattern Orientation	 				
9	Pattern Dimensions	9/	For planning. Obstacle.			
7		\$/	Require winds necessary for landing.			
8	Signal Delta/Charlie (0)	1/	9.*Only as to too close aboard. Fuel consideration.	•		
6	Nonge 0	%	Need to know for plan.			
10	Range Rate		Closure rate. Mare critical in terms of inter aircraft.			
Ξ	Time-To-Turn Milestone	9,	Decomes more important for flights of aircraft.			
2	Lateral Tracking Error					
의	-	(1.)	•Downwind.			
7	_					
2						
2	-			(1.) 2,	2, Level 62	
-	-			'l'	i, Levei 3	
≘	-			-	l, Level l	
2	Hover Azimuth Error			G.)	Except for 17/2 Vertical	
읾	Deck Status (1) 6/1	13	Amportant to adjust flight pattern (i.e., reduce A/S. Foul deck	il deck,		
7	Ship Motion		If A must know. Can you land?			
8	_					
ı	_					
- 1	-					
n	Closure Rate Error					
2	Aircraft Flight Instruments (C) (1870C) 19/	Ø.				
æ	Special Info. Regid. Cat.					
aا	-					
8	-					
8	-					
8	-					
ត <u>;</u>	-		"Multiple directif operations create significant increase info.red.	nfo.reg.		
3	Sied Sharus		a discrat of flight separation becomes critical.			

Figure 6-11-3. MC H-46 Survey of Pilot Information Requirements - Operating from LPH/LHA's, Segment 3 - Initial Approach

MATION UNEARTION	Rating Added By Pilot 2 - Task Limit Warning 3 - Safety Limit Warning Rating Provided in Evaluation Report	Marning B - Error Magnitude 1 Warning C - Error Rate-of-change D - Chance in Error Rate-Of-Change
ing Error 23 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		No. Of Pilott: 19
aition (a) 14/5 (b) 14/5 (c) 1	11.075 PILOT COMMENTS AGREE	ENGINEERING COMMENTS
ing Error 20 14/5 Ing Error 30 17/2 Info 11/6 Info 1		
iftion (0) 14/5 19/0 19/0 19/0 19/0 19/0 19/0 19/0 19/0 19/0 19/0		
ing Error 20 14/5 Ing Error 20 3 17/2 Ing Error 20 3 17/2 Ing Error 20 11/6 Ing/6 Ing/6 Ing/6 Ing/6 Ing/6 Ing/6 Ing/6 Ing/6 Ing/6 Ing/6 Ing/6 Ing/6		
ing Error 20 14/5 Ing Error 20 30 13/2 Ing Error 20 13/2 Ing Error 20 13/2 Ing Error 20 14/5 Ing Error		
ing Error 20 14/5 Ing Error 20 30 19/0 Ing Error 20 19/0 Inflor 10/0 11/8 Inflor 19/0 Inflor 19/0 Inflor 19/0		
ing Error 20 34 1970 1972 1972 1972 1971 1971 1971 1971 1972 1970 1970 1970 1970 1970 1970 1970 1970	Determines L of bank. Still important.	
ing Error 20 38 1970 1772 1772 1871 1871 1871 1871 1871 1871		
ing Error 20 38 1970 1772 1772 1871 1871 1871 1871 1871 1871		
ing Error (20) 1970 1772 1772 1772 1772 1772 1772 1772 17		
ing Error (28) 1772 inition 18/1 inition 11/8 (10) 11/8 inition 13/6 ents (10) (10) 14/5		
iffon 18/1 (1) 11/8 (1) 11/8 (1) 11/8 (1) 11/8 (1) 11/8 (1) 11/8 (1) 11/8 (1) 11/8		
(0) 14/5 (10) 14		(1.) Except for 16/4 Vertical
(D) 14/5 (D) 14/5 (D) 14/5 (D) 14/5 (D) 14/5 (D) 13/6 (D) 19/0		" 17/2 Speed/Long'l.
(D) 11/8 (D) 14/5 (D) 13/6 (D) 13/6 (D) 13/6		
(D) 14/5 (D) 14/5 (D) 14/5 (D) 13/6 (D) 13/6		
(1) 1/8 (1) 14/5 (10) 14/5 (10) 13/6 (10) 13/6 (10) 13/6		_
(D) 14/5 (D) 13/6 (D) 19/0	elmpartant if multiple flights. What's the fuel status, Foul deck	
(D) 14/5 (D) 13/6 (D) 13/6 (D) 13/6 (D) 13/6	situation, Can you land. Starting to get important.	
13/6 13/6) 13/6	Weed to be firmed up now.	
(D) 13/6 19/0 19/0		
13/6 13/0 13/0 19/0		
	T	
aity Aifftude TIEF Load Data	(1.)	
TREP Load Data		
raft Separation		
HIFT Status		
Skew/Tension indications		
Sled Status		

Figure 6-11-4A. MC H-46 Survey of Pilot Information Requirements - Operating from LPH/LHA's, Segment 4A + Final Initial Approach

									Γ
					_	Definitions	su:		
					ر 	Rating Suggested On Pilot Questionnaire Level		Type	
					4	A Rating Added by Pilot 2 - Task C	1 - Iask Control 2 - Task Limit Warning	A - Error Direction B - Error Magnitude	
					<u>.</u>	3 - Salety Rating Provided In Evaluation Report	' Limit Warning	C - Error Rate-cf-change D - Chance in Error Rate-Of-Change	
	INFORMATION		\$ / a	= \	Jan.			No. Of Blots.	7
TEM	CATEGORIES			4,	AGREE/DISAGREE	PILOT COMMENTS	_	ENTS	1
-	Identity	\vdash	F						Т
~	Inbound Heading	+	F	I					T
۳	Base Becovery Course	+	F	Ξ	0/61				Т
•	⊢	\vdash	L						Т
8	Н	Н	Ц						Τ
•	Н	Н							Т
^	Н	Н		Θ	14/3				Γ
-	-	4	\Box						
<u> </u>	_	\dashv							П
2	_	-	\Box	_					
=	Time-To-Turn Milestone	4							
12	\dashv	Н			0/61				Ė
=	-	띩			18/1		(1.) Excep	Except for 15/4 Vertical	
=	-	4	[]	2	18/1	*For prep. of wave-off.	•	" 17/2 Speed/Long'I.	
2	-	+	\Box						П
2	-+	-{	4	1					
=	_	-	\Box						7
=	-	4	\Box						
2	-	-							٦
R	-	+	\downarrow	3	12/7	Determines approx, speed, Can adjust if deck is about to clear.	1		T
۶ <u>۱</u>	-+	+	1			Foul deck situation.			7
2	Wave Off	+	1	<u>ə</u>	0%1	diave to know.			T
2	_	허	1	1	18/1	ever that critical. I usually fly a specific altitude on my rad			7
7	Hover Height	4	_	1		alt, to within 200° of the LPH.			7
ĸ	Closure Rate Error	9			10/9	Wery important,			٦
8	Aircraft Flight Instruments				(1.)				П
_	. S. I			ļ					_
a	→	4]	_					
8	-	4	\Box]					1
8	-	4	\Box	_					_
8	-	+	\exists	1					1
គ	-	+	\downarrow						_
32	Sled Status	\dashv	4						_ _[
ĺ									1

Figure 6-11-4B. MC H-46 Survey of Pilot Information Requirements - Operating from LPH/LHA's, Segment 4B - Final Close-In Approach

									\$uo		
							0	Rating Suggested On Pilot Questionnaire		Type	
							<	Rating Added By Pilot	Control Limit Werning	A - Error Direction	
							1		3 - Safety Limit Warning	b - Error Magnitude C - Error Rate-of-change	
								Rating Provided In Evaluation Report		D - Chance in Error Rate-Of-Change	
	•			_	MINGS	Ses				And the second s	
	INFORMATION			100		ar ju				No. Of Plots	
	CATEGORIES	40)	(Page)		(1 m	Marie .	NO. OF PILOTS AGREE/DISAGREE	PILOT COMMENTS	_	ENGINEERING COMMENTS	
L	Mandity		H	\vdash	┞	L					
~	I Internet Heading		\vdash	\vdash	-						
•	-		Н	\vdash	\vdash						
•	Н		Н	H	Н	Ц					
s	1			\dashv	\dashv						
2	\dashv		\dashv		Н						
1		<u>6</u> 18	<u> </u>			//1	7	Pimportant that you receive it by 4A - once you get this info,			
•	Signal Delta/Charite		H	H	L			you adjust your A/S and approach accordingly. Gillical for			
٠			H	H	L			closure rate - hover/yes.			
2	_			Н	Н						
=	-		H	Н	_						
12	_	190 1	Н	Н	Н	18/	ı,				
2	_		Н	Н	\dashv						
=	_		\exists	Н	Н						
2	_		जा का ज	ĵ.	Н	/61	(1.)		(1.) Exe	Except for 18/1 Speed/Long'1,	
2	6 Relative Altitude			्रा	Н	19/61	1			npt for 18/1 Vertical and Speed/Long'I.	
11			_ SO	\vdash	Н	18/	Ļ				
	B Lateral Hover Position	102	Н	Н	Н	/21	2	Drop lights on side would be helpful,			
61	9 Hover Azimuth Error		-	9		1	Ç,	Most important at this stage.			
8			H	Н	9	Ц		Relation to other deck aircraft. Depends on other aircraft in			
2	?] Ship Motion	30	হু হি হৈ	Q	Ц	_	Q	vicinity as well as red & green deck.			
Z	•	Ц	Н	H	0	Ц	Q	4.SE signal, Already know.			
g	\mathbf{H}	lelel		Ξ	Ц	18/1		Wiether need nor have.			
72	Hover Height		Ĩ	ပ္	Н	<u>-</u>	.00	Critical.			
22	Closure Rate Error		8	Н	Н	6/10		Extremely important; must be able to recognize close.			
8	Aircroft Flight Instruments	তাতা	NE P	<u> </u>	Н	/61	(Z)				
Ĺ	Special Info. Regid. Cat.										
\boldsymbol{a}	_		H	Н	Н				-		
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8	_		+	┥	4	4					A
8	-	1	7	\dashv	4	_					E
គ	_	1	7	\dashv	+						2-
3	2 Sled Status		1	+	4						N
L											ı.

Figure 6-11-5. MC H-46 Survey of Pilot Information Requirements - Operating from LPH/LHA's, Segment 5 - Hover

The second secon

NAEC-MISC-91-OR019 8 - Error Magnitude C - Error Rate-of-change D - Chance in Error Rate-Of-Change ENGINEERING COMMENTS (2.) Except for 13/5 Speed/Long'1. A - Error Direction No. Of Pilots: (1.) But not volidated in pilot questionnaire 1 - Tosk Control 2 - Tosk Limit Warning 3 - Safety Limit Warning Definitions Still might have to wave off for wheel going in catwalk. Wind 23. Disparee, not enough time to be playing with this; so many things happening. · Sudden pitching or rolling can leave o rate lending, this to house. See previous pages comment on relative wind. PILOT COMMENTS 24. - Important. Too high or low is critical. Rating Suggested On Pitot Questionnaire Rating Provided In Evaluation Report ocross dack. Foul dack. Rating Added By Pilot . Relative to hover. * Relative to hover. 0 4 NO. OF PILOTS AGREE/DISAGREE 15/3 (2.) 3/-17/1 12/6 2 22% 162 PATINGS N. Anmist I BOTTO का का कि कि G | G | G | G 000 20 (20 20 e Range Rote
Time-To-Turn Milestone
Lateral Tracking Error
Approach Stope Tracking Error 25 Clouse Rate Error
26 Aircroft Flight Instruments
Special Info. Req'd. Car.

7 Density Altitude Longitudinal Hover Position Skew/Tension Indications REQUIREMENT CATEGORIES Inbound Heading
Base Becovery Course
Ship Course Ambiguity
Pattern Orientonion **NFORWATION** 18 Lateral Hover Position 19 Hover Azimuth Force Signal Delta/Charlie Hover Azimuth Error Deck Stotus Ship Motion Horizontal Raference Range Milestone Obstacle Clearance VERTREP Lood Date Aircraft Separation Relative Altitude Belative Wind Hover Height HIFE Status Sled Status Wave Off

Figure 6-11-6. MC H-46 Survey of Pilot Information Requirements -Operating from LPH/LHA's, Segment 6 - Vertical Landing

NAEC-MISC-91-OR019

							Rating Suggested On Pilot Questionnaire Rating Added By Pilot Rating Provided In Evaluation Report	Definitions Level 1 - Task Control 2 - Task Limit Warning 3 - Safety Limit Warning	Type A - Error Direction B - Error Magnitude C - Error Rate-of-change D - Chance in Error Rate-Of-Change	<u></u>
TEM.	INFORMATION REQUIREMENT CATEGORIES	Joenot 4	The second	\$ 100 Meg		NGS WENT NO. OF PILOTS AGREE/DISAGREE	PILOT COMMENTS	3	No. Of Mion: 12 ENGINEERING COMMENTS	-را
	Identity		╁	H	Θ		Depends on number of ships in task force. Identity becomes more			•
7 0	Insellectuary Course		╁┤	4	旦	Ш	critical when more from one ship is present. 2. Control in heading in bover, not a factor till seg. 2.			
4	Ship Course Ambiguity	士	+	1		\perp	de la companya de la			
, 0	Pothern Dimensions	1	+	\downarrow	Έ	\perp	seconds importing with multiple districts & purents.			_
_	Н		Н	Ц	2	12/0				_
•	_	#	+	4	=	10/2	Due to multiple flights of divisions. Nice to know.			_
٤	Ronge Porce Bale	#	+	+	1	1	"With divisions of directly greater concern for time to landing.			_
=	+-	1	+	+	1	╀				<u> </u>
2	₩		Н	Ц	Ц					ì
2	-	1	+	4	4					_
2	-	1	+	4	\downarrow					
2 2	Relative Altitude	1	+	1	\downarrow					т-
2	-		Н	\sqcup	Ц					
2	-		+	4	4					
2 8	Hover Azimuth Error	1	+	-	_ [601	Pont's hard while bossion		•	-
≂	_	†	+	L	1		Million de la constant de la constan			
2			Н	Ц	Ц					_
8	-+	1	+	4	1					_
* *	Hover Height	\pm	+	4	\downarrow					_
8	Aircroft Flight Instruments	N D	od halod	Ļ	\downarrow	12/0				, ,
_	4 X I									
a	-		dash	Ц	Ц					_
8	-+	1	\dashv	4	4					
8	Aircroft Separation	1	+	+	\downarrow					-
3 2	-	#	+	+	1			-		_
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Figure 6-12-1. MC H-53 Survey of Pilot Information Requirements - Operating from LPH/LHA's, Segment 1 - Homing

4 11 3

A family added by Pilot Change Control Manual Control Change Change	Parting Suppose On their Continuous 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1										Definitions		
A balling Actived by Pilot 1 - Train Lines Whening 1 - Train Lines Whening 1 - Train Lines Whening 1 - Train Lines Whening 1 - Train Lines Whening 1 - Train Lines Whening 2 - Train Lines Whening 2 - Train Lines Whening 2 - Train Lines Whening 2 - Train Lines Whening 2 - Train Lines Whening 2 - Train Lines Whening 2 - Train Lines Whening 2 - Train Lines Whening 2 - Train Lines Whening 2 - Train Lines Whening 2 - Train Lines Whening 2 - Train Lines Whening 3 -	District District								5	Kazng Nagested On Pilot Questionnaire	Level	Type	
ANINGS ALTHOUGH THE STATE	NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBER NUMBE										2 - Tosk Limit Warning	B - From Mognitude	
Mo. Of Rich. 12 Mo. Of Richts 12 Mo. Of R	1 1 1 1 1 1 1 1 1 1										Bustumas stutt Acatos - S	C - Error Rate - Of-Change D - Chance in Error Rate - Of-Change	·
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	A A A A A A A A A A	3	INFORMATION	\ \frac{\sqrt{\chi}}{\chi}			1	a m))				
9/2	17	3	UNEMENT	407		2/2/2	W. ~	0 1	FEE Y	PILOT COMMENTS		ENGINEERING COMMENTS	ر
0 9/2 48C determines morbed) grinntsiton. 0 1/7	120 120	Monthly		L	╀		t		1				,
0 9/2	10 10 10 10 10 10 10 10	Inbound Needing	Aing		H	П	Н		П				
10 10 10 10 10 10 10 10	10 10 10 10 10 10 10 10	Poor	y Cours	日	Н	Ц		6/6	1	-BRC determines marshall orientation.			
in 120 120 120 120 120 120 120 120	No. 12/0 13	3	Ambiguity	士	+	1	at a	1922	†				_,_
Altern (C.) 17/1 (Advantages of alternth, in lingue plane operations possible, but in autition alternal necessary feavoral alternal necessary feavoral alternal necessary information). This becomes very important (1.) Except for 1970 vertical information, this becomes very important (1.) Except for 1970 vertical information (1.) Vertical information (Marie Marie		and one	1	+	Í	ŧ	12.00	1				
After (C) 9/2 (Authors of alcredit, be ling to place operations could be, but in multiple districting to teach of 12/0 (in multiple districting to teach of 12/0) (in multiple distriction). This becomes very important to a need of mid-offn. After (C) 12/0 (in multiple distriction). This becomes very important to a need of mid-offn. After (C) 12/0 (in multiple distriction). This becomes very important to a need of mid-offn. After (C) 12/0 (in multiple distriction). This becomes very important to a need of mid-offn. After (C) 12/0 (in multiple distriction). This becomes very important to a need of mid-offn. After (C) 12/0 (in multiple distriction). This becomes very important to a need of mid-offn. After (C) 12/0 (in multiple distriction). This becomes very important to a need of mid-offn. After (C) 12/0 (in multiple distriction). This becomes very important to a need of mid-offn. After (C) 12/0 (in multiple distriction). This becomes very important to a need of mid-offn. After (C) 12/0 (in multiple distriction). This becomes very important to a need of mid-offn. After (C) 12/0 (in multiple distriction). This becomes very important to a need of mid-offn. After (C) 12/0 (in multiple distriction). This becomes very important to a need of mid-offn. After (C) 12/0 (in multiple distriction). This becomes very important to a need of mid-offn. After (C) 12/0 (in multiple distriction). The need of mid-offn. After (C) 12/0 (in multiple distriction). The need of multiple distriction to a need of mid-offn. After (C) 12/0 (in multiple distriction). The need of multiple distriction to a need of multiple distriction. After (C) 12/0 (in multiple distriction). The need of multiple distriction to a need of multiple distriction. After (C) 12/0 (in multiple distriction). The need of multiple distriction to a need of multiple distriction. After (C) 12/0 (in multiple distriction). The need of multiple distriction to a need of multiple distriction. After (C) 12/0 (in multiple distriction). The need of multiple distri	Million (1.7) Security in the consequence of all control of the co	Belotive Wind	P.	1	+	I	E	1/1	1				,,
Ag Error (C) 12/0 in multiple altereth recovering or terms 10 12/0 in socional sery insperiori 11/0 is oned mid edit. 11/0 is oned mid edit. 11/0 is oned mid edit. 11/0 is oned mid edit. 11/0 is oned mid edit. 11/0 is oned mid edit. 11/0 is oned mid edit. 11/0 is oned mid edit. 11/0 is oned mid edit. 11/0 is oned mid edit. 11/0 is oned mid edit.	Miles Mi	2	/Charlie	t	+	Ī	ŧ	5/6	۲	extenders of aircraft. In single plane operations po	esible, but in		_
13/0 13/0 1 10 13/0 1 10 13/0 1 10 13/0 1	120 120 150		, Company	1	+	I	E	12/0	1	multiple afrorall recovery beveral afroraft recov	vering at same		_
Alf GOT 12/0 No good dail of solts. Alf GOT 12/0 (1,1) Eccept for 11/1 Vertical Alf GOT 12/0 (1,2)	Alter (1.) Except for 11/1 Varieties (1.) Except for 11/1 Vari	200		T	+	Ĺ	E	12/0		time not necessarily information). This becomes	very important,		
Million Mil	Marine Ma	120	rn Wilestone		+		E	0/21		to avoid mid-airs.			
	Mage VI-	July 1	king Error	L	+		-						}
(1,) Ecopy for 1)/7 Vertical (1,		S 458	lope Tracking Error	L	+	L	+						
	Hen (1.) Eccept for 11/1 Vertical (1.) Eccept for 11/1 Vertical (1.) Eccept for 11/1 Vertical (1.) Eccept for 11/1 Vertical (1.) (1.) (1.) (1.) (1.) (1.) (1.) (1.)	Mile	hone		-		-						
	PAGE VI-	10	epronce		-		H					npt for 11/7 Vertical	
	PAGE VI-	Relative Altitude	Inde		-		Н		П				
### (C(V) (C	PAGE VI-	24.30	Hover Position		-		Н						~ · T
## 1/- ##	PAGE VI-	P Fox	er Position		H		Н						- T
### (GAR IC 12/0 0.)	PAGE VI-	Azim	uth Error				1		7				٠,٠
with (CONT) (CONT) (CONT) (CONT)	PAGE VI-	Deck Status			Н		Z	7.	1				_
ents (GW) (C 12/0 U.)	PAGE VI-	Ship Motion					Ž	:/2	7				-
	PAGE VI-	You Off			-		Н						_
ments (CGW) [CC 12/0 (0.)	PAGE VI-	layer	leference		-								_
Men (GM C 12/0 (U.)	PAGE VI-	Hover Height	2		H		H						-
min ((G)(1)(G) 12/0 (1.)	PAGE VI-	, Po	te Error	1	Н		Н		7				-
100	PAGE VI-	P HO	ight Instruments	MON	I II C		Н						_
on dications	Ad Date acation in indications	56	Special Info. Reg'd. Cat.										-
on dications	PAGE VI-	18 A J	Hhude		Н		\dashv		1				1
	PAGE VI-	1	ood Date		\dashv		-		1				√
	PAGE VI-	S HO	paration		+		1		1				E
	PAGE VI-	HIFE Status			H				1				C
	PAGE VI-	/Jens	on Indications		Н		1	}	1				-1
	PAGE VI-	Sied Status			<u> </u>								11
Figure 6-12-2. MC H-53 Survey of Pilot Information Requirements -							(7. 444	44.03		

Figure 6-12-2. MC H-53 Survey of Pilot Information Requirements - Operating from LPH/LHA's, Segment 2 - Orientation

۱ , .							0	Rating Suggested On Pilot Questionnaire	Level 1 - Tack Control	Type A - Error Direction
L									0.000	A - trror Direction
L							<	Rating Added By Pilot	2 - Task Limit Warning	B - Free Atomitude
L							1		3 - Safety Limit Warning	C - Error Rate - of - change
L								Rating Provided In Evaluation Report		D - Chance in Error Rate-Of-Change
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-	Ship Course Ambiguity		\dashv	4	_	4				
٠,	Pattern Orlentation]	+	4	9	_	1			
٥	Pattern Dimensions	1	+	4		\$	1			
\dashv	Belative Wind	_	┥	4	2	_	-	Effect on lateral range.		
-4	Signal Delta/Charite		+	4	9	4	7			
_	lange		\dashv	4		<u>ورا</u>	-	Caterally. To set up constant 180" position.		
0	Ronge Rate		+	4	2	_				
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12 17	Lateral Tracking Error		Н	Н						
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14	Ronge Atlestone		Н	Н						
15 0	Obstacle Clearance		Н	Щ	Ц					
1	Relative Altitude		Н	Ц	Ц					
1	Longitudinal Hover Position		H	4	_				(1.) Exc	Except for 10/2 Speed/Long'I.
)8 L	Lateral Hover Position		Н	Н	Ц					8/3 Vertical
19 H	Hover Azimuth Error		_	4						
0 O	Deck Status		\dashv	4		ğ				
5 12	Ship Motion		_	Н						
7 22	Wave Off		Н	Н	_					
23	Harizontal Reference		\vdash	_						
72	Hover Height		\vdash	H	L					
25	Closure Rate Error		۲	H	L					
20	Aircroft Flight Instruments	0	ວທ່ອນໄວນ	S		0/11	() ()	"Going from delta to charile pattern. Poor 1800 screws up entire	ews up enfire	
Š	Special Info. Reg'd, Cat.	Ĺ						approach. Starting low or high may lead to wave-off.	₁∽off.	
2	Density Alithude		一	\vdash	<u> </u>					
22	VERTREP Load Date		\vdash	H	L					
8	Aircraft Separation		\vdash	-	L					
-	HIFE Status		-	\vdash	1					
31	Skew/Tension Indications		H	Н	L					
32 \$	Sled Status		_	_						

Figure 6-12-3. MC H-53 Survey of Pilot Information Requirements - Operating from LPH/LHA's, Segment 3 - Initial Approach

			;			Rating Suggested On Pilot Questitonnaire Rating Added By Pilot Rating Provided In Evaluation Report	Juestionnaire n Report	Definitions Level 1 - Tosk Control 2 - Tosk Limit Worning 3 - Safety Limit Worning	g.	Type A - Error Direction B - Error Magnitude C - Error Rate-of-change D - Chance in Error Rate-Of-Change	. 8	
	PAFORMATION	1 >	3		1					No. Of Pilots:		
3	CATEGORIES	Party	West .	WARA	NO. OF PILOTS AGREE/DISAGREE		PILOT COMMENTS	_	ENC	ENGINEERING COMMENTS		
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0	Pettern Dimensions	\pm	I	+								
~	Relative Wind	\vdash		0	6/8						!	
	Signal Delta/Charille			E	1/-							
•	Range	-		+								
2	Ronge Bate	+	1	+								
=	Time-To-Turn Milestone	1	1	\dagger							Ī	_
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: 2	Obstocie Clearance	-		+				(1)	1 1	Except for 9/3 Speed/Long'I.		
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17	Longitudinal Hover Position	Н		\dashv								
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18	—	\pm		1	7 7 7							
7	Hover Height	-		H								
2	Closure Rate Error			H								
8	şį	(S)		-	17.1	"Critical area of flight. Fit inst. provide cues that cause pilot to	st. provide cues that a	couse pilot to			T	
*	pecial Into. Keq'd. Cat.		ļ	1		determine task limits. Allitude very critical	hde very critical.					
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Figure 6-12-4A. MC H-53 Survey of Pilot Information Requirements - Operating from LPH/LHA's, Segment 4A - Final Initial Approach

	·.			3	Z	0 4 🗆	Rating Suggested On Filot Questionnaire Rating Added By Filot Roting Provided in Evaluation Report	Definitions Level 1 - Task Control 2 - Task Limit Warning 3 - Solety Limit Warning	Type A - Error Direction B - Error Avagnitude C - Error Rate-of-change D - Chance in Error Rate-Of-Change	
WE.	INFORMATION REQUIREMENT CATEGORIES	18-84-07	190	Contract of the second of the	anjishing y	NO. OF PILOTS AGREE DISAGREE	PILOT COMMENTS	_	No. Of Pilots: ENGINEERING COMMENTS	1
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4	Ship Course Ambiguity	H	\vdash	耳	H					Π
۰۱۰	Pottern Dimensions	+	+	I	+					1
-	Relative Wind	H	Н		Ð	8/3	Determine A/C or pilot limitations.			T
8	Signal Delia/Charille	\forall	\dashv		E P	-7/-				
0	-	+	+	1	+					Т
≥ =	Time-To-Turn Milestone	+	+	I	+			-		T
2	Lateral Tracking Error	201	H		Н	19/1				
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8	Horizontal Reference	LO LO	2		1	*/2	"Not needled yet.			_
2	Hover Height			Ц	H					П
2	Closure Rate Error	4			+		"Critical in H-53, improper closure rate makes transition to a			
6	pacial Info. Reald. Cat				1	(1) (1)	MOVER LANGUE.			T
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ř	See Series	-	╢	1	1					T

Figure 6-12-48. MC H-53 Survey of Pilot Information Requirements - Operating from LPH/LHA's, Segment 4B - Final Close-In Approach

NAEC-MISC-91-OR019
PAGE VI-63 Type
A - Erra Direction
B - Erra Magnitude
C - Erra Rate-of-change
D - Chance in Errar Rate-Of-Change (1.) Except for 10/1 Lateral and Vertical ENGINEERING COMMENTS No. Of Pilots: Level
1 - Task Control
2 - Task Limit Warning
3 - Safety Limit Warning Definitions Speed Indicator in operation below 40 kts. Other elecret tuning. Relation to other alread? huning an deck. PILOT COMMENTS Rating Suggested On Pilot Questionnaire Rating Provided In Evaluation Report "No problem with this segment Rating Added By Pilot Especially for H-53. 0 4 AGREE/DISAGREE (1) 9/11 2 22 222252222 MINGS g 0 POSILIA POSILIA POSILIA धा विवास 20 25 20 21 (7 21 69 ŞQ 9 Range
10 Range Rate
11 Time-To-Turn Milestone
12 Leteral Tracking Error
13 Approach Stope Tracking Error
14 Approach Stope Tracking Error
15 Change Milestone
15 Change Clearance
16 Relative Alithae
17 Langindinal Hover Position
19 Hover Azimuth Error
20 Deck Stetus
21 Ship Motion Closure Rote Error
 Aircraft Flight Instruments
 Special Info. Req'd. Cat.
 Density Altitude HIFR Status Skew/Tension Indications INFORMATION REQUIREMENT CATEGORIES 23 Horizontol Reference
24 Hover Height
25 Closure P Base Becovery Course Skip Course Ambiguity Pattern Orientation Pattern Dimensions 8 Signal Delta/Charille 28 VERTREP Load Date Aircraft Separation Inbound Heading Belotive Wind Sled Status

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Figure 6-12-5. MC H-53 Survey of Pilot Information Requirements -Operating from LPH/LHA's, Segment 5 - Hover

				•		ZI Z	7 1	Rating Suggested On Pilos Questionnaire Rating Added By Pilos Rating Provided In Evaluation Report	Level 1 - Task Control 2 - Task Limit Warning 3 - Safety Limit Warning	Type A - Error Direction B - Error Arganitude C - Error Rate-of-change D - Chance in Error Rate-Of-Change	
Į	INFORMATION	~~		100		ارميرا				No. Of Mion:	1
TEM		\$ 5 P		(<u>)</u>	(A)	· ·	NO. OF PILOTS AGREE/DISAGREE	PILOT COMMENTS	_	ENGINEERING COMMENTS	
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7	Base Recovery Course		Н	Н	${m H}$	\prod					П
*	SNp Course Ambiguity		\dashv	4	4						
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•	Pathern Dimensions	1	\dashv	\dashv	4	-					
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	Signal Delta/Charite	H	Н	H	,	\downarrow		wind automatically.			_
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=	-		Н	Н	4						
=	4	1	4	-	4	4					<u>.</u>
2	-	\exists	\dashv	4	4	4			- t		Ţ
=	Bonge Milestone		4		4	-			1	Except for 10/2 Vertical	Т
~	Obstacle Clearance	30 30	흵			=	7		(2.) 2,	2, Level #3 Instructive	Т
2	_	4	4	4	-	-			-	Level #3 Instructive	_
-1	Longitudinal Hover Position	90		\dashv	_	2	ę				_
2	Lateral Hover Position	30	Н	Ц	Ц	12	ę				7
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8	-	-}	4	4	4	_	_				I
~	-	20 20 20	뙳	닑	_{	_		Ship motion & horizon reference are interconnected. Should be	ed. Should be		-
2	Wave Off		4	4	₫	_	(z)	in first category. For CH-53.			-
8	Horizontal Reference	<u> </u>	9		4	*	9/3				1
7	-		9	5	4	=	_				-
2	_		Н	\dashv	4						1
8	Aircroft Flight Instruments		\dashv	\dashv	ᅴ	_					7
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Definitions

Figure 6-12-6. MC H-53 Survey of Pilot Information Requirements - Operating from LPH/LHA's, Segment 6 - Vertical Landing

NAEC-MISC-91-OR019 A - Error Direction
B - Error Magnitude
C - Error Rote-of-change
D - Chance in Error Rate-Of-Change 2 ENGINEERING COMMENTS No. Of Pilots: 1 - Task Control 2 - Task Limit Warning 3 - Safety Limit Warning **Definitions** Level in case a larger ship or alternate is available. Nice to know for planning. Critical if operating at limits of range & EMCON, PILOT COMMENTS Rating Suggested On Pilot Questionnaire Rating Provided In Evaluation Report A Rating Added By Pilot NO. OF PILOTS AGREE/DISAGREE 222222 § 2 3 MINGS (A) (A) (A) Approach Slope Tracking Error Bunge Milestone Obstocle Clearence Relative Altitude Longitudinal Hover Position 22 Wove Off
23 Horizontal Reference
24 Hover Height
25 Closure Role Error
26 Aircroft Flight Instruments
Special Info. Req'd. Cat.
27 Density Altitude Aircraft Separation
HIFR Stokes
Skew/Tension Indications INFORMATION REQUIREMENT CATEGORIES Time-To-Turn Milestone Leteral Tracking Error Ship Course Ambiguity Pattern Orientation Lateral Hover Position Signal Delta/Charlie 28 VERTIEP Load Date
29 Aircraft Separation Pattern Dimensions Hover Azimuth Error Belative Wind Deck Status Ship Motion Sled Status 8 2

Figure 6-13-1. MC H-1/H-46/H-53 Survey of Pilot Information Requirements -Operation from LPH/LHA's, Segment 1 - Homing

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NAEC-MISC-91-OR019 A - Error Direction
B - Error Magnitude
C - Error Rate-of-change
D - Chance in Error Rate-Of-Change I ENGINEERING COMMENTS No. Of Pilots: Level
1 - Task Control
2 - Task Limit Warning
3 - Safety Limit Warning Definitions PILOT COMMENTS Rating Suggested On Pilat Questionnaire Rating Provided In Evaluation Report A Rating Added By Pilot 0 NO. OF PILOTS AGREE/DISAGREE \$ 2/- 1W1, 1W2 A 5/- 41v 1, 11v3 2/- 1 1/ 1/ 1/ 1/3 272 14/0 13/1 13/2 **FATINGS** 103/10A ာ်ကြောက် Ronge Rate
Time-To-Turn Milestone
Lateral Tracking Error
Approach Stope Tracking Error
Ronge Milestone
Obstocle Clearance
Relative Allithuse Longitudinal Hover Position Lateral Hover Position Closure Rate Error Aircraft Flight Instruments Skew/Tension Indications INFORMATION REQUIREMENT CATEGORIES Ship Course Ambiguity Pattern Orlentation Pattern Dimensions Relative Wind Inbound Heading Hover Azimuth Error Deck Status Ship Motion Signal Delta/Charlie Special Info. Reg'd. Cat. Horizontal Reference Hover Height Density Afritude VERTREP Load Data Aircraft Separation HIFR Shatus LZ Altitude Wave Off Identify duo

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Figure 6-13-2. MC H-1/H-46/H-53 Survey of Pilot Information Requirements -Operation from LPH/LHA's, Segment 2 - Orientation

PAGE VI-66

Definitions

NAEC-MISC-91-OR019 A - Error Direction
B - Error Nagnitude
C - Error Rote-of-change
D - Chance in Error Rate-Of-Change 2 ENGINEERING COMMENTS No. Of Pilots: Level 1 - Tosk Control 2 - Tosk Limit Warning 3 - Safety Limit Warning Definitions PILOT COMMENTS Must know final inbound course to turn to. Rating Suggested On Pilot Questionnaire If descending, need obstacle clearance, Rating Provided In Evaluation Report Rating Added By Pilot Continuous information 4 NO. OF PILOTS AGREE/DISAGREE 3/- 21/1,11/2 8 4 - 3 W 1, 1 W 8 25225 12/0 12/0 <u>\$</u> MINGS ৰ d (CO)(CO) Lateral Tracking Error
Approach Slope Tracking Error
Range Milestone
Clastocle Clearance
Relative Altitude
Longitudinal Hover Position 27 Density Altitude
28 VERTREP Load Data
29 Aircraft Separation
30 HIPR State
31 Sew/Tension Indications
32 LZ Altitude 25 Closure Rate Error 26 Aircraft Flight Instruments REQUIREMENT CATEGORIES Inbound Heading
Base Becovery Course
Ship Course Ambiguity Time-To-Turn Milestone **INFORMATION** Wave Off Harizontal Reference Haver Height Lateral Hover Position Special Info. Reg'd. Cat Signal Delta/Charlie Hover Azimuth Error Pattern Orientation Pattern Dimensions Relative Wind Ship Motion Deck Status Range Rate

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Figure 6-13-3. MC H-1/H-46/H-53 Survey of Pilot Information Requirements -Operation from LPH/LHA's, Segment 3 - Initial Approach

PAGE VI-67

Definitions

NAEC-MISC-91-OR019
PAGE VI-68 A - Error Direction
B - Error Magnitude
C - Error Rate-of-change
D - Chance in Error Rate-Of-Change ENGINEERING COMMENTS No. Of Pilots: Levet 1 - Task Control 2 - Task Limit Warning 3 - Safety Limit Warning Definitions Continuous information. For indication of possible wave aff. PILOT COMMENTS Rating Suggested On Pilat Questionnaire Rating Provided In Evaluation Report Rating Added By Pilot (\$ 5/- 21/3, 21/1, 11/2 (\$ 4/- 21/3, 11/1, 11/2 1/1/1/-4 ጠ 8/2 <u>1/</u> 4/- 2 ኒላ), 1 ኒላ 2 4, 1 ኒላ NO. OF PILOTS AGREE/DISAGREE 3 1/-3 4/- 3 Lv 1, 1 Lv 3 3 1/-200 10/01 28 5 2 Lv 1 RATINGS 6 Jenes Jeogpe CO (QU) CO | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Milestone | Range | Milestone | Range | Milestone | Range | Milestone | Range | Milestone | Range | Milestone | Range | Milestone | Range | Milestone | Range | Milestone | Range | Milestone | Range | Milestone | Range | Milestone | Range | Milestone | Range | Milestone | Range | Milestone | Range | Milestone | Range | Milestone | Range | Milestone | Range | Milestone | Range | Milestone | Range | Range | Milestone | Range | Range | Milestone | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Range | Rang 15 Obstacle Clearance
16 Belentive Altitude
17 Longitudinal Hover Position
18 Lateral Hover Position
19 Hover Azimuth Error
20 Deck Status
21 Ship Motion 23 Horizontal Beference
24 Hover Height
25 Cloure Rate Error
26 Aircraft Flight Instruments
Special Info. Req'd. Cat. Skew/Tension Indications LZ Altitude INFORMATION REQUIREMENT CATEGORIES Inbound Heading
Bee Becovery Course
Ship Course Ambiguity
Pottern Orientorion
Pottern Dimensions Wave Off
Horizontal Reference
Hover Height Belative Wind Signal Delta/Charlie Density Altitude VERTIEP Load Data Aircraft Separation HIFR Status identity

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Figure 6-13-4A. MC H-1/H-46/H-53 Survey of Pilot Information Requirements - Operation from LPH/LHA's, Segment 4A - Final Initial Approach

Definition

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							(,	1	Definitions		
							 	Rating Sugg	Rating Suggested On Pilot Questionnaire	Level	Type	_
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							4	✓ Koting Added by Pilot	ed by Pilot	2 - lask Limit Warning 3 - Sofety Limit Worning	6 - Error Magnitude	_
						-			Rating Provided In Evaluation Report		D - Chance in Error Rate-Of-Change	
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~	Inbound Heading		+	\vdash	٤	<u>-</u> /-						T
၉	Base Recovery Course	H	H	Н	И	1/2						
•	Ship Course Ambiguity		Н	Н	Н							_
S	Pattern Orientation		-	-	4	Ц						•
•	Pathern Dimensions	1	\dashv	\dashv	Н							
^	Relative Wind		\dashv	\dashv	9	1) 6/2						
•	Signal Delta/Charite		Н	Н	V	N 3/-						
٥			Н	Н	Н							
2	Range Rate		Н	Н	Н							
Ξ	Time-To-Turn Mifestone		Н	Н	_							
12	Lateral Tracking Error	2	H	Н	Н	90						
2	Approach Slope Tracking Error)	30	d	4	<u>~</u>						
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15	Obstacle Clearance		Н	Н	2	5	v3, 2 Lv 1, 1 L	Lv 1, 1 Lv 28				-
2	-		Н	Н	2	-/9	2 Lv3, 1 Lv 1, 1 Lv 2 Vert, 1 Lv 28, 1 Lv 2	×2/vert, 1 Lv2!	8, 11, 2			
17	Longitudinal Hover Position		-	_	7	⅍	2 Lv 1, 1 Lv 2B					-
2	Н	Н	Н	Н	N	-/6	2 Lv 1, 1 Lv 28					
19	Hover Azimuth Error		H	H	-	_						
8	-	H	Н	Н	Я	ζ\$ W						
2	-		Н	Н	_							
8	Wave Off	₫	4	\dashv	ପ୍ର							1
g	Horizontal Reference	NOVO	g	\dashv	4	7		-				٦
7,	Hover Height		Н	4	4							
2	Closure Rate Errar	(20)	3	\dashv	4	8/- 31	8/- 31,28,2 Lv 18, 1 Lv 3, 1 Lv 3D	11/3, 1 LV3D				- -
8	Aircraft Flight Instruments)(O)		b	H	\$ 						7
ν.	Special Info. Reg'd. Cat.					}						
a	Density Altitude		-	┝	H	_						 [
8	VERTIEP Load Data		\vdash	\vdash	\vdash	_						
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ñ	Skew/Tension Indications		Н	Н	Н							
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Figure 6-13-4B. MC H-1/H-46/H-53 Survey of Pilot Information Requirements - Operation from LPH/LHA's, Segment 4B - Final Close-In Approach

Definitions

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								C	Rating Suggested On Pilot Questionnaire	Definitions	· · · · · · · · · · · · · · · · · · ·	
) <	Backer Andread By Diles	1 - Tusk Control	A - Error Direction	
								1		3 - Safety Limit Warning	6 - Error Magnitude C - Error Rate-of-channe	
				•	SOMITAG	ě			Rating Provided in Evaluation Report		D - Chance in Error Rate-Of-Change	 -
	INFORMATION	~		100		• Vi					No. Of Plots	
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-	Identity	t	┝	┞	▙	L						1
~	Inbound Heading	t	\vdash	Ļ	Ŀ							
9	Base Recovery Course	Н	Н	\dashv	Ц	Ц						_
4	Ship Course Ambiguity	+	4	\dashv	4	Ц						
~	Pattern Orientation	+	4	4	\downarrow	\perp						Γ.
┙	ions	1	4	_{	4							ii
7		<u> </u>	Š	(38)(38)(38)		(3)	Vect 7-38 Ar	38 A.				- -
8	Signal Delta/Charite	H	Н	Ц	Ц							
6	Range	\vdash	-	L	L	L			•			
2	_	H	┞	L	L	L						
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12	Lateral Tracking Error	8	\vdash	L		6	Q				+ 101	•
13	Approach Slope Tracking Error	+	\vdash	L	L							
=	Range Milestone	H	H	L	L	L						
15	Obstecle Clearance		Ē		L		2					1
16	Relative Altitude	<u>g</u>	F	lo	L	_	4					
11	Longitudinal Hover Position	12	20	┞	L	٥	2		Assume unprepared fwd site.			
2	Lateral Hover Position	e	+	\vdash	L	ď	6					
2	Hover Azimuth Error	+	\vdash	(E	L	8	و					i
8	-	\dagger	+	1	6	6	11,2,31	Lv2, 3 Lv 1, 1 Lv 3b, 1 Lv 3	D. 11v3			:
2	Ship Mohian	00 00 00	980	L	L	_	9					
z	Weve Off	H	-	\vdash	<u> </u>	8						
23	Horizontal Reference		1)(0	<u></u>	L		7					
24	Hover Height	۲	ř	O	L		7					
z	Closure Rate Error	(82)		H	L		2/2					
8	Aircroft Flight Instruments	Z 0 7	<u>12</u>		\sqcup		ę					·
3	Special Info. Reg'd. Cat.											
a	Density Altitude	\vdash	\vdash	L	L	L						
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32	Sled Status			_	لـــا	<u>_</u>						;-/
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Figure 6-13-5. MC H-1/H-46/H-53 Survey of Pilot Information Requirements - Operation from LPH/LHA's, Segment 5 - Hover

NAEC-MISC-91-OR019 A - Error Direction
B - Error Magnitude
C - Error Rate-of-change
D - Chance in Error Rate-Of-Change ENGINEERING COMMENTS No. Of Pilots: Level
1 - Task Control
2 - Task Limit Warning
3 - Safety Limit Warning Definitions From hover to set down, all information has been used; only PILOT COMMENTS Rating Suggested On Pilot Questionnaire visual reference used to feel for around. Rating Provided in Evaluation Report Rating Added By Pilot 4 8.0 5/3 1/-8-20 Cet /-20 Vert, V 8-38 LBF, 7-38 Vert, V NO. OF PILOTS AGREE/DISAGREE MINGS (3) (3) (3) (3) (3) **100000000** 20 20 20 圕 (8) 1 Time-To-Turn Milestone
2 Laferal Tracking Error
3 Approach Slope Tracking Error
4 Range Milestone
5 Obstocle Clearence
6 Reletive Altifude
7 Longfudinal Hover Position Aircreft Separetion
HIFE Setus
Stew/Tension Indications 26 Aircraft Flight Instruments Special Info. Regid. Cat. INFORMATION REQUIREMENT CATEGORIES Inhound Heading
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Pathern Dimensions
Reletive Wind Ship Molian Wave Off Harizontal Reference Hover Height Closure Rate Error Lateral Hover Position Signel Delta/Charlie Hover Azimuth Error VERTIEF Load Date Density Alithude Range Range Bate Deck Status 32 Sled Status

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Figure 6–13–6. MC H-1/H-46/H-53 Survey of Pilot Information Requirements – Operation from LPH/LHA's, Segment 6 – Vertical Landing

PAGE VI-71

Definitions

							Definitions		_
						<u> </u>		Туре	
							1 - Tosk Control 2 - Tosk Limit Warning	A - Errar Direction B - Errar Magnitude	-
]	3 - Safety Limit Warning	C - Error Rate-of-change	_
						_	Rating Provided in Evaluation Report	D - Chance in Error Rate-Of-Change	
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Ŀ	+-	\vdash	L	Ĺ	Θ	143			. —,
	+-	┞	L	Ĺ	L	14/3	Gross weight may require into the wind. Obstacle clue,		
-	Signal Delta/Charite	L	L	Ĭ	Θ	1//1	Delay time.		,
•	┢	-		Ĺ	Ψ	2/21			_
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2	-	H	Ц	1	_	1/-			
3	_	Ц	Ц		₽	1/-			
2	-	Ц			$\Phi \mathbf{E}$	7 1 2 1 1 V	ž		
2	—	Н	Ц		Ø	//	Need to know if aircraft is clear.		
2	Longitudinal Hover Position			\Box	V	γ-			
Ē	Lateral Hover Position		Ц		Ð	7-			
2	-			_	◀	1/-			1
8	\vdash	\dashv	Ц		┫	Ş	Don't heed while homing, Delay time,		
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Z	2 Wave Off	-	4		4	-}-			
8	I	Н	4		4	1/-			
*	6 Hover Height	-			┫	٧.			
2	Closure Rate Error	4	\sqcup		₫	-/-			
8	Aircroft Flight Instruments	(c) (b) (c)	2		Θ				
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8	Aircraft Separation		욁		ब	4	If multi aircraft operation.		A.E
8	_	\dashv	4	1	1			,	:C
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Figure 6-14-1 MC H-1/H-46/H-53 Survey of Pilot Information Requirements - Operating from Landing Zones, Segment 1 - Homing

Part Part						0	Rating Suggested On Pilot Questionnaire	Lavel	Туре	
Proceedings Process						٥	Rating Added By Pilot	1 - Task Control 2 - Task Limit Warning	A - Error Direction B - Error Magnitude	
PRIOR PRIO								3 - Satety Limit Warning	C - Error Rate-of-change	
REQUIREMENT				2	TINGS	,.	Koling Movided in Evaluation Report		D - Chance in Error Rate-Ot-Change	
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2 belowed belowy Calcana 47. Diseasined fight pottern, tenn to decentricly etc. 4 Shy Cares Ackledry 10.7 Diseasined fight pottern, tenn to decentricly etc. 5 Parties Observed Consideration 14.7 Warrag pathern scales which in the fight pottern, tenn to decentricly etc. 6 Parties Observed Consideration 14.7 Warrag pathern scales which in the fight pottern in the fight pottern in the fight pottern in the fight pottern in the fight pottern in the fight pottern in the fight pottern in the fight pottern in the fight pottern in the fight pottern in the fight pottern in the fight pottern in the fight pottern in the fight pottern in the fight pottern pottern in the fight pottern pottern in the fight pottern potter	_	Identity			Ø	3/1	Hard to keep. Hard to maintain reference.			
3 Bell Benowey Chares (1) M4/2 Cheeving Entern. John to deprend of the control of t	3	Inbound Heading		F	W	-/4				
4 She for an Anhabelity (1) 14/2 Wing pattern coins wore off & contains. 4 Nettern Oriensation (1) 14/2 Wing pattern coins were off & contains. 5 Nettern Oriensation (1) 14/2 Ming pattern coins were off & contains. 6 Signal Dally/Chells (1) 14/2 Signal Dally/Chells (1) 14/	0	State Recovery Course		H	Θ	14/2	Determines flight pattern, turn to downwind, etc			
5 National Colorabilities (1) My2 Niverg patients clean work off & contailor. 7 Babilities Wifeda (1) My3 Safe creas clear. First consideration will increase this. 9 Expend Delivin/Clearities (1) My3 Safe creas clear. First consideration will increase this. 10 Increase will be larger and the safe of the	•	Ship Course Ambiguity			Θ	14/2				
6 Septed Daily/Chairle (1) 14/0 Safe areas clear. Fool consideration will increes filt. 9 Septed Daily/Chairle (1) 14/1 Safe areas clear. Fool consideration will increes filt. 10 Bange Stee (1) 14/0 Chaircle in Free Free Free Free Free Free Free Fre	2	Pattern Orlentation		L	Θ	14/2	Wrong patterns cause wave offs & confusion.			т-
2 Belative Wind (1) 13/1 Side area cleer. Fast consideration will increase thit. 9 Begal Daily/Cheetie (1) 14/2 Chance in Free. 10 Begal Entry Cheetie (1) 14/3 Chance in Free. 11 Begal Entry Cheeting Entry (1) 14/3 Chance in Cleaners 12 Appendix In Cleaners (1) 2/- 2/- 13 Appendix Increase Militaria (1) 2/- 2/- 14 Interpretating Entry (1) 2/- 2/- 15 Interpretating Entry (1) 2/- 2/- 16 Interpretating Entry (1) 2/- 2/- 17 Interpretation Free Patient (1) 2/- 2/- 18 Interpretation Free Patient (1) 2/- 3/- 21 Sept Absolute (1) 2/- (1) 4/7 22 Hours Ballet (1) 2/- (1) 4/7 23 Hours Ballet (1) 2/- (1) 4/2 24 Hour Ballet (1) 3/- (1) 4/4 25 Harden (2) 4/- (2) 4/- 26 Altered Fight Interpretation (2) 4/- (3) 4/- 27 Altered Fight Interpretation (2) 4/- (3) 4/- 28 A	۰	Pathern Dimensions		Ĺ	Θ	\$ <u>1</u>				Τ-
9 Bages Bages 14/2 Chatck in Free Interest 0 14/2 Chatck in Free Interest 0 14/2 Chatck in Free Interest 0 14/2 Chatch in Free Interest 0 14/2 Chatch in Free Interest 0 14/2 Chatch in Free Interest 0 14/2 Chatch in Free Interest 0 14/2 Chatch in Free Interest 0 14/2 Chatch in Free Interest 0 14/2 Chatch in Free Interest 0 14/2 Chatch in Free Interest 0 14/2 Chatch in Free Interest 0 14/2 Chatch in Free Interest 0 14/2 Chatch in Free Interest 0 14/2 Chatch in Free Interest 0 14/2 Chatch in Free Interest 0 14/2 Chatch in Free Interest 0 14/2 Chatch in Free Interest 0 1/2 Chatch in Chatch in Chatch in Chatch in Chatch in Chatch in Chatch in Chatch in Chatch in Chatch in Chatch in Chatch in Chatch in Chatch in Chatch in Cha		Belative Wind		F	Θ	1/51	Safe areas clear. Fuel considerations will increa	e this.		٦-
10 Bunge Beet (1√0) Check Is free. 11 Time-To-Turn Militations (1√0) Check Is free. 12 Laise Bank To-Ching Error (1√0) Check Is free. 14 Bunge Militation (1√0) (1√0) 15 Checke in Cleanonce (1/0) (1/0) 16 Laise I beer Position (1/0) (1/0) 17 Long Indian I beer Position (1/0) (1/0) 18 Laise I beer Position (1/0) (1/0) 19 Lever Asianus Fror (1/0) (1/0) 20 Beel Satus (1/0) (1/0) 21 Wheel Satus (1/0) (1/0) 22 Hover Heigh Intervenin (1/0) (1/0) 23 Aircraft Right Intervenin (1/0) (1/0) 24 Hover Heigh Intervenin (1/0) (1/0) 25 Aircraft Saperalion (1/0) (1/0) 26 Aircraft Saperalion (1/0) (1/0) 27 Death Ail Nature (1/0) (1/0) 28 Aircraft Saperalion (1/0) (1/0) 29 Aircraft Saperalion (1/0) (1/0) <	-	Signal Delta/Charite		Ĺ	e	14/2				, -
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1 Time-To-Torn Milesbone 14/0	2	⊢			ε	16/0				-, -
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19 Hover Azimuth Eror		_								i
20 Deck Stelve On H/2 He jas plan final. 21 Ship Motion A Sy- He jas plan final. 22 House Male stellerence A Sy- He jas plan final. 23 House Weight A I/- I/- 24 Hover Height A I/- I/- 25 Closure Rate Error A I/- I/- 26 Aircraft Flight Instruments I/C/(IB/C) I/- 30 Lactor Flight Instruments I/C/(IB/C) I/- 30 VETTES Load Date I/- I/- 30 HIRS Stelve I/- I/- 31 LZ Stee I/- I/- 32 Airthurds of LZ I/-	2									,
23 Ship Medion	ل	-			Θ	14/2			•	, ,
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Density Alifthude A	S	pecial info. Regid. Cat.				Broadle at				,
VERTIEF Load Date A	α	I		L						
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12 Size 1/- 1/	8	-								-
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	33	_			€	<u>'</u>				

Definitions

Figure 6-14-2 MC H-1/H-46/H-53 Survey of Pilot Information Requirements - Operating from Landing Zones, Segment 2 - Orientation

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i	1	1	Ī	PAGE	VI-74

							Definitions	tions		
						<u> </u>	Rating Suggested On Pilot Questionnaire		Туре	-
								1 - Tosk Control	A - Error Direction	-
						4	Rating Added By Pilot	2 - Tosk Limit Worning 3 - Cofety Limit Worning	B - Error Magnitude	
							sociated control of habitation	ווא רווויוו אמנטונט	C - Error Rate-of-change	_
			-	2	MINGS	7			U - Chance in Error Rate Or Change	
	INFORMATION		•	?.á		1		AND CONTRACTOR OF THE PERSON NAMED IN CO		ŀ
l	IEQUIREMENT	\ <u>`</u>	Š	8	~	13,			No. Of Pilots:	1
¥_		8 60/2			12/	AGREE/DISAGREE	PILOT COMMENTS		ENGINEERING COMMENTS	
Ŀ	Identity		┝		\blacksquare	\$	Small LZ hard to keep in sight.			- T
~	┝		<u> </u> _		Š	5/- 21,2,21,1,11,2	-			
~	Н		H	L	Θ		3 if it changes. Determines this particular partion, i.e. downwilled.	www.hd.		Τ
•	Ship Course Ambiguity		H	L	Θ	2/-	If incus or heading must know.			Τ
~	Н		-	L	Θ	12/2	2 of BRC changes.			Т
9	Н		\vdash	L	Θ	1/61	For safety abstacle clearance.			7-
1	Seletive Wind		\vdash		Θ	10/4				ŋ -
•	Signal Delia/Oarlie		Н		ΙωΙ	1/61				
•	_		Н		IωI	2/21				ı
2	_		Н		Θ	Q/Y1				-
=	$\overline{}$		Н		JΩI	£/11	Rate of turn/angle of bank must be small, i.e., less than or			
12	Н	H	Н	Ц	W	-/1	equal to SRT.			
13	_		Н	Ц						
*			Н							-
12	Obstacle Clearence	Н	Н		18 8 (6/- 3-25, 1-2C Vert &	During pattern.			į
18	I		Н			-1/-				
11	Longitudinel Hover Position		_							
=	_		Н	Ц						-
-	Hover Azimuth Error		_							
8	\blacksquare	Ħ	Н	Н	$\overline{\mathbb{C}}$	£/11_				į :
2	Ship Motion		-		$ \Psi $	-/1				
Z	_		Н	Ц	$ \Psi $	1/1				:
g	Horizontal Reference		_		$ \nabla$					
72	_		H	Ц						1
2	Closure Rate Error		₹			٠/-				
8	Aircraft Flight Instruments)(O)	(c)(n)(c)			13-1C Lat, 13-1C Vert,				. 1
Ľ	Special Info. Reg'd. Cat.					Buon de au au				
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8	$\mathbf{-}$		\vdash	L						i
æ	-		Н							N
8	-		\dashv							IA.
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8	HH Obstacle Readout				₫	1/-]-
		Ì						•		N

Figure 6-14-3 MC H-1/H-46/H-53 Survey of Pilot Information Requirements - Operating from Landing Zones, Segment 3 - Initial Approach

								Definitions		
						<u> </u>	Rating Suggested On Pilot Questionnaire	Level	Type	
						4	Rating Added By Pilot	1 - lask Control 2 - Task Limit Warning	A - Error Direction 8 - Error Magnitude	
								3 - Safety Limit Warning	C - Error Rate-of-change	
						_	Reting Provided In Evaluation Report		D - Chance in Error Rate-Of-Change	
	•			_	MINGS	4GS			and the second s	_
	INFORMATION				1	1			1 2 2	
ITEM	REQUIREMENT CATEGORIES	7	(MAN TO SERVICE AND ADDRESS OF THE PARTY OF T	AGREE/DISAGREE	PILOT COMMENTS		ENTS	-
<u> </u> -	Identity	1	T	+	悸	<u> </u>				
2	Inhound Heading	L	L	+	K					-
3	Base Becovery Course	\sqcup		Н	É	Ц				
4	Ship Course Ambiguity			Н	H					
5	Pattern Orlentation	\prod		H	4	Ц				
•	Pothern Dimensions	4	1	\dagger	\$	-/-				
\	Belantive Wind	4	1	+	9		38 if drastic change.			
•	Manai Della/Charile	+	1	\dagger	╬					
•	-	4	1	\dagger	\$					
2	-	4	1	\dagger	1	2/3				
=:	Time-To-Turn Affestone	_	1	+	+					
2	-	25	Ţ	+	+	-/21				
2	-	1	1	3	-					
•	-	4	Ī	₹	1					
2 4	Parlation Although	+	1	4	≸					
12	-	\downarrow	1	\dagger	╀					
81	Interest House Position	\downarrow	Ţ	+	+					-
2	-	-	t	+	\vdash					
8	_	Ц		Н	Θ	1/11	LZ status if other aircraft are in LZ,			
ĮŽ.	_	Ц		\dashv	4					
u	Wave Off	Ц		\dashv	뎩	%				
B	-	4	1	\dashv	\dashv					
콨	-4	4		+	+					
ß	-+	4		+	+	%				
8 3	Aircroff Flight Instruments pecial Info. Rea'd. Cat.	2		3	\dashv	11-15 Sp/Long.				
a	Dennity Alithote	╀		H	\vdash					
8	VERTIEF Load Date	╀	L	\vdash	\vdash					N.
8	Arcreft Separation	L		H	H					Al
30	•	H		Н	Н					EC
16	Althoris of LZ	Н		H		-/1				-/
32	Obstacle Beadout				€					M)
										5

Figure 6-14-4A MC H-1/H-46/H-53 Survey of Pilot Information Requirements - Operating from Landing Zones, Segment 4A - Final Initial Approach

				(Detinitions		
				Rating Suggested On Pilot Questionnaire	aire Level	Type	
					1 - Task Control	•	
				A Rating Added By Pilot	2 - Task Limit Worning 3 - Safety Limit Warning	ng B - Error Mognitude	
				Rating Provided in Evaluation Report			hange
•		MTINGS					
	//	\ <u>``</u>	1 / 5%			No. Of Pilots	2
TEM	CATEGORIES SALVA	WAR	AGREE/DISAGREE	PILOT COMMENTS	ENTS	ENGINEERING COMMENTS	
I _	Identity	٤	14/-21/3, 11/28, 11				
~	Inbound Heading	K	36 3/- 11,3C, 11,3, 11,1A	Y.'1			 ;
-	Base Becovery Course	0	1/2				
4	Ship Course Ambiguity	ľ					
5	Pathern Orientation	\SZ	-/1				
9	Pottern Dissensions	L					
4	Belative Wind	Θ	10/4				-
•	Signal Delta/Charille	W	-/-				; ;
٠	Range	77	12/- 1 Lv 2, 1 Lv 28				
10	Range Rate	SZ.	1/2				
11		W	-/-				!
2	(20)	Ц	11/3				
2	Approach Slope Tracking Error 30						:
14		0	1				
15	Obstocie Clearonce		//- itv	ZI, TLy Z Vert II Ly ZB Vert			
91	Belotive Affinds	Œ		, 15, 00, 1 LV 30, 1 LV. 3			1
1		∇	-/-				
2	Lateral Hover Position	W	-/-				1
2	Hover Azimuth Error	_					
8	Deck Status	Θ	12/2			•	
12	Ship Mation	Ø	2				!
2		(D)	12/2				1
R	Horizontal Reference / 10/10	-	12/2				
z	Hover Height	W]				
R	Closure Rote Error	_	%				
8	Aircraft Flight Instruments (10) (18) (10)	-	14 - 15 (91, 12-10 Var	/04/			
l _n	Special Info. Reg'd. Cat.		Buon ide as as				
8	Density Altitude	\vdash					•
8	VERTIEP Load Date	H					
8	Aircraft Separation	Н					:
8	HIPR Stotus	-					\E
5	Skew/Tension Indications						· · · · · · · ·
32	Obstacle Readout	⋖	<u>'</u>				
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Figure 6-14-48 MC H-1/H-46/H-53 Survey of Pilot Information Requirements - Operating from Landing Zones, Segment 4B - Final Clase-In Approach

								Definitions		
						О 	Rating Suggested On Pilot Questionnaire	Level	Type	
						_	Roting Added By Pilot	1 - Task Control 2 - Tock Limit Warning	A - Error Direction	
								3 - Safety Limit Warning	6 - Error Magnitude C - Error Rate-of-chanse	_
						<u>⊔</u>	Rating Provided in Evaluation Report	•	D - Chance in Error Rate-Of-Change	
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Inbound Heading	L	╀	╀	8		-/-				
Bose Becovery Course		\vdash	\vdash	1	L					-
Ship Course Ambiguity	L	\vdash	\vdash	H	L					
Pathern Orlantation		-	\vdash	P		-/-				T
Pattern Dimensions		Н		_	1	1/-				1
Seletive Wind	60 60 60	161 6	<u> </u>	L	27.2	12-38 Vert	12-381ot /-38 Vert 12 Relative wind will not limit operations unless radii	redically.		
Signal Delta/Charite		L	-	۲	-		ı			-
Range		\vdash	H	र		-/-				-
Ronge Rate		\vdash	H	8	0	-/1				
Time-To-Turn Milestone			Н	Ļ						!
Lateral Tracking Error	02	Н	Н	Н	Н	17/1				!
Approach Slope Tracking Error		4	4	₫		-/-				
Range Milestone		4	4	₹	•	1/-				
Obstocle Cleorence	30			Н	3 K	01, 8-35 Vert,				!
Relative Altitude	Н	Š	Ę	Н		12/1				
Longitudinal Hover Position		(20)	H	ļ	L	1/21				
Lateral Hover Position	(SO)	Н	\vdash	H		1/21				
Hover Azimuth Error		_	$oldsymbol{\epsilon}$			11/2			•	!
Deck Status	H	Н	\vdash	0		2/6	Most important at this stage.			
Ship Motion	व्यक्ति	[20 29	_	L		12/1				
Wave Off		H	H	<u>e</u>		13/0				
Horizonial Reference		U		Щ	12-18	Lat, Long, Vert,				
Hover Height	Н		Ę	L		11/2				
Closure Rate Error		1	Н	_		9/2	Excessive closure should require safety war is result of vertical	of vertical		
Aircraft Flight Instruments	San,	121	L	\vdash	192-61	Lot , 13-25 Vert,	_	rafes may		
Special Info. Reg'd. Cat.				1	*	Jan Dong.	ļ			:
Density Altitude		\vdash	H	-	L					
VERTREP Load Doto		-	+	+	-					1
Aircraft Separation	\perp	+	\vdash	+	-					IA
HIFT Status	E	H	\vdash	\vdash	L					E
Skew/Tension indications		Н	Н	Н	Н					:
Sled Status		<u> </u>	-	-	_					M
		1	H	#	1				:	il E

Figure 6-14-5 MC H-1/H-46/H-53 Survey of Pilot Information Requirements - Operating from Landing Zones, Segment 5 - Hover

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								Definitions		
						_	Rating Suggested On Pilot Questionnaire	Level	Type	_
						_		1 - Tosk Control	A - Error Direction	
						4	Kating Added by Miot	2 - Josk Limit Warning 3 - Safety Limit Warning	8 - Error Magnitude	_
							Rating Provided In Evaluation Report		C. Crist Rate Of change D - Chance in Error Rate-Of-Change	
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•	Ship Course Ambiguity	\dashv	4	4	_					
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-	Signal Delta/Charlie	+	4	4	1					
•	Range	\dashv	4	4						
2	Ronge Rote	\dashv	4	_						
=	Time-To-Turn Milestone	\dashv	Ц							
2	Laherol Tracking Error	Н	Ц	Ц	Ц					
2	-4	\dashv	4	_	┙					
Ξ	Range Milestone	-	4	4	_	_				-
2	Obstacle Clearance	30 (SC) (SC) (SC)		2		A-38 Long, 4-38 Aut	3B (Lat, Vert, Long, Azi) & from other aircraft already landed.	landed.		
2	-	-{	4	4	8					-
	iffon	3		4	1	77				
=	Lateral Hover Position	6	4	4	1	1//				
2	-	+	4	3		7/2				
8	Deck Status	-{	4	4	_	20110				
<u>≂</u>	Ship Mation	20 20 20	5		_	7-30 Ver.				
7	Wow Off	4	_{	ļ	1					
8	Horizontal Reference		킰	ا	_	S				
2	-4	4		٦	_	1//			1	
ដ	Closure Rate Error	-	4	4				-		
8	Aircraft Flight Instruments		L							
<u>~</u>	Special Info. Reg'd. Cat.									
a	Density Altitude	H	Н	Ц	Ц					
8	VERTIEF Load Data	Н	Ц	Ц	Ц					N
£	_	\dashv	4	Ц						A
8	_	\dashv	Ц	Ц	Ц					EC
ก	_	Н	Н	Ц	Ц					
32	Sled Status	_	_		L					M
]										113

Figure 6-14-6 MC H-1/H-46/H-53 Survey of Pilot Information Requirements -Operating from Landing Zones, Segment 6 - Vertical Landing

NAEC-MISC-91-OR019 A - Error Direction B - Error Magnitude C - Error Rote-of-change D - Chance in Error Rote-Of-Change ENGINEERING COMMENIS No. Of Pilots: Level
1 - Task Control
2 - Task Limit Warning
3 - Safety Limit Warning molly Due to multiple flights of divisions not factor till Seg 2. Occasion Definitions Not needed, if aircraft heavy, important to plan for each.

Nice to know, Critical if you're low fuel state or have multiple
flights, Several flights arriving same time, Critical fuel. several marshalling points, Cr Citical if you have multiple flights, Critical if you have mare than I' pattern. PILOT COMMENTS Critical. Depends on I of ships in took force. Rating Suggested On Pilot Questionnaire Important for fuel state considerations. Rating Provided In Evaluation Report Rating Added By Pilat 10. Nice to know. Nice to know. Like to know. Nice to know Citical 0 4 NO. OF PILOTS AGREE/DISAGREE 222<u>222</u>2 × % 2 MINGS I BONIES Θ (O(n)(n) 9 Range
10 Renge Bate
11 Unes-To-Turn Milestone
12 Saleval Ynesking Error
13 Approach Slope Tracking Error
14 Renge Milestone
15 Obstocle Clearence
16 Relative Alithode
17 Langitudinal Hover Pasition
18 Lateral Hover Pasition INFORMATION REQUIREMENT CATEGORIES Aircraft Separation
HIFE Status
Skew/Tension indications Special info. Reg'd. Cat. Patential Heading
Bee Recovery Course
Ship Course Ambiguity
Pattern Orientation Pottern Dimensions Relative Wind Signal Delta/Charille Horizontol Reference Hover Azimuth Error Density Altitude VERTIEP Load Data Closure Rate Error 20 Deck Status 21 Ship Motton Hover Height Wove Off ME a

MC H-1/H-46/H-53 Survey of Pilot Information Requirements -Operating from Landing Zones, Segment 1 - Homing Figure 6-15-1

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INFORMATION INFORMATION							0 4 🗆	Rating Suggested On Filot Questionnaire Rating Added By Filot Rating Provided In Evaluation Report	Level) - Task Control 2 - Task Limit Warning 3 - Safety Limit Warning	Type A - Error Direction B - Error Magnitude C - Error Rate-of-change D - Chance in Error Rate-Of-Chunge
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Being Recovery Course (2) 4/- 2 Lv 1, 2 Lv 1	~	Inbound Heading	-							
Ship Course Ambiguity (2) 4/- 3 Ly 2, 1 Ly 1. Pertern Orientetion (2) 4/- 3 Ly 2, 1 Ly 1. Pertern Orientetion (3) 4/- 3 Ly 2, 1 Ly 1. Relative Wind (1) 6/2 Signol DelicyCharlie (1) 6/2 Range (1) 6/2 Range Robe (1) 8/0 Ilme-To-Turn Milestone (1) 8/0 Lateral Face Signor (1) 8/0 Range Milestone (1) 8/0 Charling Error (1) 8/0 Langitudinal Haver Ration (1) 8/0 House Alithude (1) 8/0 Ship Motion (1) 8/0 Wove Off (1) 8/0 Haircraft Filght Instruments (1) 8/0 Hours Role Error (1) 8/0 Aircraft Filght Instruments (1) (1) (1) (1) (1) (1) (1) (1) (1) (1)	က	Base Becovery Course	H	П	Ĭ		_	Critical to flight pattern if multiple fire. BRC detern	mines marshalf	
Perfern Orlentetion	•	Ship Course Ambiguity	\vdash		Ĺ			orientation. Fixed course at SATS sight.		
Pertram Dhenesions	9	Pattern Orlaniation	H		Ĭ	-/•		Terrain clearance. Critical if multiple flights.		
Signal Delay/Charle	9	Pattern Dheensions	L		Ĭ	W W				
Signal Delay/Charlie	_	Belative Wind	L]			Need to know.		
Range 10 2/6	•	Signal Delta/Charite	L		Ĕ			Numbers of aircraft. Land ops obstacle clearance ta	akes greater	
Nonger Rohe (1) 840	6	Ronge	_		_			significance. Critical if multiple fils.		
Time To-Turn Milestone (1) 8/0 Lateral Tracking Error Approach Slope Tracking Error Rate Milestone Carbon Milestone Langi Nullinal Hover Position Lateral Hover Position Lateral Hover Position Lateral Hover Position Lateral Hover Position Lateral Hover Position Lateral Hover Position Deck Stetus Ship Molion Wove Off Horizontal Reference Hover Height Closure Rate Error Aircraft Filight Instruments Closure Rate Error Aircraft Filight Instruments Density Ailstude Aircraft Separation HIRE Status Sterw/Tension Indications Sied Status Sterw/Tension Indications	9	Ronge Rote	L		Ĭ			9. Critical in mountainous terrain. Terrain clearand	. 60	
Lateral Tracking Error Approach Stope Tracking Error Approach Stope Tracking Error Charles Milestone Redrive Altifuce Langihudinal Hover Position Lateral Hover Position Lateral Hover Position Lateral Hover Position Lateral Hover Position Hover Azimuth Error Ship Motion Wave Off House Azimuth Reference Hover Height Closure Rate Error Aircraft Filight Instruments Aircraft Filight Instruments Density Altitude Aircraft Separation HIRS Status Starw/Tension Indications Starw/Tension Indications	1	Time-To-Turn Milestone	Н		Ĭ					
Approach Slope Tracking Error Range Milestone Chestrale Clearance Relative Alth Late Langhudinal Hover Position Langhudinal Hover Position Langhudinal Hover Position Dock Stehus Ship Motion Wover Azimuth Error Ship Motion Wover Height Cleaver Rate Error Aircraft Filight Instruments Density Althode VERTREP Load Doto HIRE Stehus Stew/Tension Indications Stew/Tension Indications	12	Loteral Tracking Error	Н	Ц	Ħ					
Range Milestone Obstacle Clearence Relative Altitude Languid Mileston Hover Azimuth Error Ship Motion Wave Off Horizoft Filight Instruments Cleare Role Error Aircroft Filight Instruments VERTRE Load Data Aircroft Separation HIR Stetus Steaw/Tension Indications Steaw/Tension Indications	13	Approach Slope Tracking Error	\dashv							
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Leneral Hover Position Hover Azimuth Error Dealt Status Ship Motion Wound Off Horizontal Reference Hover Height Closure Rate Error Aircraft Flight Instruments Deaulty Aith Inde Aircraft Separation HIPS Status Staw/Tension Indications Staw/Tension Indications Staw/Tension Indications	17	Longitudinal Hover Position								
Hover Azimuth Error Dock Steha Ship Molian Wove Office Hover Height Cleare Rate Error Aircraft Filight Instruments VERIEFE Load Data Aircraft Specialion HIR Steha Stew/Tension Indications Stew/Tension Indications	18	Loteral Hover Position	H							
Ship Motion Ship Motion Wove Office of the Ship Motion Howard Reference Howar Height Closure Role Error Aircraft Flight Instruments Density Altitude VERTEE Load Data Aircraft Separation HIR Status Starw/Tension Indications	6	Hover Azimuth Error								-
Ship Motton Wave Off Wave Off Hort Inhalt Reference Hort Inhalt Reference Hort Inhalt Reference Hort Inhalt Reference Aircraft Filight Instruments Density Alithade VERTEE Load Data Aircraft Separation HIR Status Staw/Tension Indications	8	Deck Status	Н				1			
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Horizontal Reference Hover Height Closure Rale Error Aircraft Flight Instruments (ICATB) (ICATA) Pacial Into, Rey'd. Cat. VERTIEF Load both Aircraft Separation HIPE Status Stew/Tension Indications	22	Wave Off	-							
Hover Height Closure Role Error Aircraft Flight Instruments (CONB)(C) 7-16 Spriture Density Aithude VERIEF Load Bone Aircraft Separation HIPE Status Stew/Tension Indications	ß	Horizontal Reference	-							
Aicraft Flight Instruments (COD) 7-16 Sp/Lory Special Info. Red d. Cat. Dentity Aith de Aicraft Specialion HIP Status Stew/Tension indications	24	Hover Height	Н							
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Density Aliftude VERTRE Load Data Aliccalif Separation HIRS Status Staw/Tension indications	%	ents		S	Ц	1/-10 101, 6-1		Critical if multiple flights,		
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	12	Density Affitude	Н							
	8	VERTIEP Load Doto	\dashv							
\rightarrow	8	Aircraft Separation	Н	Ц						
\rightarrow	8	HIFR Status	\dashv							
_	ຣ	Skew/Tension Indications	4	\Box						
	32	Sled Status	႕							

Definitions

Figure 6-15-2 MC H-1/H-46/H-53 Survey of Pilot Information Requirements - Operating from Landing Zones, Segment 2 - Orientation

NAEC-MISC-81-OR019 A - Error Direction
B - Error Magnitude
C - Error Rate-of-change
D - Chance in Error Rate-Of-Change ENGINEERING COMMENTS No. Of Pilots: 1 - Task Control 2 - Task Limit Warning 3 - Safety Limit Warning Definitions Level PILOT COMMENTS Rating Suggested On Pilot Questionnaire Only as to too close aboard closure rate. Rating Provided In Evaluation Report A Rating Added By Pilot Multiple aircraft, Mountain areas. Downwind. 0 3-1C Lat. .-1C Vert. NO. OF PILOTS AGREE/DISAGREE 2/- 11,2,11,3 5855888 2/1 1/2 MINGS Arimum POSITON PROSITON **Ideal** Range Rote
Time-To-Turn Milestone
Lateral Tracking Error
Approach Slape Tracking Error
Bange Milestone 17 Longitudinal Hover Position
18 Lateral Hover Position
19 Hover Azimuth Error
20 Deck Stetus
21 Ship Motion 22 Wave Off
23 Harizontel Reference
24 Haver Height
25 Closure Rate Error
26 Aircraft Flight Instruments
Special Info. Reg'd. Cat.
27 Density Altitude Skew/Tension indications Sted Status 3 Base Recovery Course
4 Ship Course Ambiguity
5 Perfern Orientedron
6 Pertern Dimensions REQUIREMENT CATEGORIES **NFORMATION** Signal Delta/Charlie Obstacle Clearance Relative Altitude Aircraft Separation HIFR Status VERTIEP Load Data Inbound Heading **Belative Wind**

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Figure 6-15-3 MC H-1/H-46/H-53 Survey of Pilot Information Requirements -Operating from Landing Zones, Segment 3 - Initial Approach

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NAEC-MISC-91-OR019 Type
A - Error Direction
B - Error Magnitude
C - Error Rate-of-change
D - Chance in Error Rate-Of-Change ENGINEERING COMMENTS No. Of Pilots: Level
1 - Task Control
2 - Task Limit Warning
3 - Solety Limit Warning Definitions PILOT COMMENTS Rating Suggested On Pitot Questionnaire Critical in mountains, Obstacle elegence for land operations. Rating Provided In Evaluation Report Rating Added By Pilot 4/- 2 Lv 28, 2 Lv 18 |5-1C Lat, 3-1C Vert, / Critical area of flight, |4-18 Sp/Cong. 0 4 NO. OF PILOTS AGREE/DISAGREE (1) 4/- 2-3C, 2-38 / 2 2 2 KATINGS SANUTEN TO SHOOT PROPERTY OF THE PROPERTY OF T 18 2 behound Heading
3 Bess Recovery Course
4 Ship Course Ambiguity
5 Pattern Dissentions
7 Belative Wind
8 Signal Delia/Charits
9 Range
10 Range Rate
11 Time-To-Turn Misstone
12 Lateral Tracking Error
13 Approach Slope Tracking Error
14 Bange Milattone
15 Characte Clearance
16 Belotive Clearance
16 Belotive Clearance
17 Langitudinal Hover Position
18 Lateral Hover Position
19 Deck Status
22 Wood Off
23 War Admust Error
24 Hover Height Lestruments
25 Clease State Error
26 Aircraft Flight Lestruments
27 Clease State Error
28 Aircraft Flight Lestruments
30 Hiffs Status
31 Stew/Ternstone Indications
31 Stew/Ternstone Indications INFORMATION REQUIREMENT CATEGORIES

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Figure 6-15-4A MC H-1/H-46/H-53 Survey of Pilot Information Requirements -Operating from Landing Zones, Segment 4A - Final Initial Approach

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Definitions

NAEC-MISC-91-OR019 D - Chance in Error Rate-Of-Change A - Error Direction
B - Error Magnitude
C - Error Rate-of-change ENGINEERING COMMENTS No. Of Pilots: Level
1 - Task Control
2 - Task Limit Warning
3 - Sofety Limit Warning Definitions Improper closure rate makes transition to a hover unaffe. PILOT COMMENTS Rating Suggested On Pilot Questionnaire Rating Provided In Evaluation Report For preparation of wave off. A Rating Added By Pitor Have to know 1) 8/- 21, 14,2, 11, 14 Lat (1) 4/- 3 LV IT I LVZA LA 3-1C Lot, 3-1C Sp/Long 1/3 15 [at. 3-10 Vert,] NO. OF PILOTS AGREE/DISAGREE |\$|\$ 3 3 MATINGS 0 <u>රා(ආ) රා</u> 00 00 1 Tiese-To-Turn Milestone
2 Lateral Tracking Error
3 Approach Stope Tracking Error
6 Range Milestone
5 Obstocle Clearance 17 Longitudinal Hover Position
18 Lateral Hover Position
19 Hover Azimuth Error
20 Deck Stetus
21 Ship Motion 25 Closure Rote Error
26 Aticcaft Flight Instruments
Special Info. Reg'd. Cat.
27 Density Altitude
28 VERTEE Load Data Skew/Tension Indications INFORMATION REQUIREMENT CATEGORIES Base Becovery Course SNip Course Ambiguity Pathern Orientation Pottern Dimensions Relative Wind Wave Off Harizontal Reference Signal Delta/Charite Aircraft Separation HIPE Status Relative Aithude Inbound Heading Hover Height 9 Range 10 Range Rate Sled Status

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Figure 6-15-4B MC H-1/H-46/H-53 Survey of Pilot Information Requirements -Operating from Landing Zones, Segment 48 - Final Close In Approach

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Definitions

NAEC-MISC-91-OR019 A - Erra Direction
B - Erra Magnitude
C - Errar Rata-of-change
D - Chance in Errar Rata-Of-Change ENGINEERING COMMENTS No. Of Mon: Level 1 - Tosk Control 2 - Tosk Limit Warning 3 - Safety Limit Warning Definitions PILOT COMMENTS Rating Suggested On Pilot Questionnaire Rating Provided in Evaluation Report △ Roting Added By Pilot LSE signal NO. OF PILOTS AGREE/DISAGREE 2 MINGS (1) (1) (1) (1) (1) (1) 29 (2) 29 (3) 29 (3) 19 29 20 20 20 20 20 8 00 9 Range Bete
10 Range Bete
11 Illea-To-Turn Milesbone
11 Laterol Tracking Error
12 Approach Stope Tracking Error
13 Chestocle Clearance
14 Barge Milesbone
15 Chestocle Clearance
16 Laterol Hover Position
17 Longinginging Hover Position
18 Laterol Hover Position
19 Hover Aziauth Error
20 Deck Stehs
21 Skip Motion
22 Wove Off
23 Hartzonkel Reference
24 Hover Height 77 Denuity Altitude
78 VERTREP Load Date
78 Aircraft Separation
30 HIFR Stehs
31 Stew/Tension Indications 26 Aircraft Flight Instruments Special Info. Reg'd. Cat. INFORMATION REQUIREMENT CATEGORIES Inhound Heading
Bere Becovery Course
Skip Course Ambiguity
Pathem Orleshellon
Puthem Dissentions
Reletive Wind
Signal Delty/Charile

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Figure 6-15-5 MC H-1/H-46/H-53 Survey of Pilot Information Requirements -Operating from Landing Zones, Segment 5 - Hover

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Definitions

Sted States

NAEC-MISC-91-OR019 A - Error Direction
B - Error Magnitude
C - Error Rate-of-change
D - Chance in Error Rate-Of-Change ENGINEERING COMMENTS No. Of Pilots: Level
1 - Task Control
2 - Task Limit Warning
3 - Safety Limit Warning Definitions PILOT COMMENTS Rating Suggested On Pilot Questionnaire Rating Provided in Evaluation Report Rating Added By Pilot 0 4 ~ 1 Ly 10, 1 Ly 20 ~ NO. OF PILOTS AGREE/DISAGREE 2/-1 Ly 2D, 1 Ly 3D 2 2 222 2 MINGS Te (Te) (Te) 39 39 39 39 <u>ez</u> 8 30 3 9 Range
10 Ronge Rote
11 Time-To-Turn Milestone
12 Lateral Tracking Error
13 Approach Slape Tracking Error
14 Range Milestone
15 Obstocle Clearance 16 Beletive Althhode
17 Longhudinal Hover Pesition
18 Lateral Hover Pesition
19 Hover Azimuth Error
20 Deck Stehse
21 Ship Morion 22 Wave Off
23 Horizontal Reference
24 Hover Height
25 Closure Rate Error
26 Aircraft Flight Instruments
5pecial Info. Req'd. Cat.
27 Density Aliftude
28 VERTEF Load Date HIFE Status Stew/Tension Indications INFORMATION REQUIREMENT CATEGORIES Base Becovery Course
 Ship Course Ambiguity
 Pattern Orleanorion
 Pattern Dissensions
 Belative Wind 7 Relative www. 8 Signal Delta/Charite Aircraft Separation Inbound Heading Sled Status TEM

Figure 6-15-6 MC H-1/H-46/H-53 Survey of Pilot Information Requirements - Operating from Landing Zones, Segment 6 - Vertical Landing

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Definitions

NAEC-MISC-91-OR019 A - Error Direction
B - Error Magnitude
C - Error Rate-of-change
D - Chance in Error Rate-Of-Change ENGINEERING COMMENTS No. Of Mion: 1 - Task Control 2 - Task Limit Warning 3 - Safety Limit Warning Definitions identify ship to follow heading. We need instruction and a Primary consideration is the correct ship selection. Need to Level PILOT COMMENTS Rating Suggested On Pilot Questionnaire Fuel/Distance capability/Limitations. Closure rate. visual slope indicator on the ship Rating Provided In Evaluation Report A Rating Added By Pilot 0 AGREE/DISAGREE NO. OF PILOTS 4 123232323 QQ $\overline{\epsilon}$ (O)((a)((c) 9 Bange | 10 Bange | 10 Bange | 10 Bange | 11 Times-To-Turn Milestone | 12 Lebenel Trackling Error | 14 Bange halfschape | 15 Clebele Milestone | 15 Clebele Milestone | 16 Balestive Alfithode | 17 Lengthullinel Hover Peatition | 18 Lebenel Hover Peatition | 19 Lebenel Hover Peatition | 10 Balestive Alfithode | 17 Lebenel Hover Peatition | 18 Lebenel Hover Peatition | 19 Lebenel Hover Peatition | 10 Balestive Alfithode | 17 Lebenel Hover Peatition | 18 Lebenel Hover Peatition | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 Balestive | 10 B Alrorath Separetion HIFE Sohus Shew/Tendon Indications Aircraft Flight Instruments Special Info. Reg'd. Cat. INFORMATION IEQUIREMENT CATEGORIES beaund Heading line Recovery Course Sile Course Ambiguity Pattern Orienterion 21 Ship Motion 22 Wave Off 23 Horizonial Reference 24 Hover Halght 25 Closure Bote Errer Signed Delta/Charitte Hover Azianuth Error Deck Status Pottern Dimensions Beledive Wind Sled Stehe

Figure 6-16-1 MC H-1/H-46/H-53 Survey of Pilot Information Requirements -Operating from Landing Zones, Segment 1 - Homing

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NAEC-MISC-91-OR019 A - Erra Direction
B - Erra Nagnitude
C - Erra Rote-of-change
D - Chance in Erra Rote-Of-Change ENGINEERING COMMENTS No. Of Miohi: Level 1 - Task Control 2 - Task Limit Warning 3 - Safety Limit Warning Definitions PILOT COMMENTS Rating Suggested On Pilot Questionnaire Rating Provided In Evaluation Report △ Roting Added By Pilot (2) 3/- 11\(\begin{array}{c} 1 \) 1\(\beta 2 \end{array}\) 2/1 (1) 3/0 (2) (3) 3/0 (4) 3/0 (4) 3/0 (5) 0 NO. OF PILOTS AGREE/DISAGREE 5825888 **COKONICO** 1 Ship Course Anabigative
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29 Adversif Flight Instruments
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33 Steps/Torridon Instruments
34 Steps/Torridon Instruments
35 Sand Steps
31 Steps/Torridon Instruments INFORMATION REQUIREMENT CATEGORIES

Figure 6-16-2 MC H-1/H-46/H-53 Survey of Pilot Information Requirements - Operating from Landing Zones, Segment 2 - Orientation

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Definitions

Figure 6-16-3 MC H-1/H-46/H-53 Survey of Pilot Information Requirements - Operating from Landing Zones, Segment 3 - Initial Approach

NAEC-MISC-91-OR019 A - Error Direction
B - Error Magnitude
C - Error Rate-of-change
O - Chance in Error Rate-Of-Change ENGINEERING COMMENTS No. Of Pilots: Level
1 - Task Control
2 - Task Limit Warning
3 - Safety Limit Warning Definitions PILOT COMMENTS Rating Suggested On Pilot Questionnaire Rating Provided In Evaluation Report Rating Added By Pilot 0 4 NO. OF PILOTS AGREE/DISAGREE 2 ន្ត ⋦ MINGS (a) (b) 8 9 Bange
10 Ronge Rote
11 Time-To-Turn Milestone
12 Lateral Frecking Error
13 Approach Stope Trecking Error
14 Bange Milestone
15 Obstocle Clearence
16 Relative Alifthuse 17 Longhudinal Hower Position
18 Lateral Hower Position
19 Hower Azlandh Error
20 Dack Steha
21 Ship Motion
22 Wave Off 25 Clopure Bath Error
26 Aircraft Flight Instruments
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27 Density Altitude
28 VERTEP Load Date MIFR Status Skew/Tension Indications INFORMATION IEQUIEEMENT CATEGORIES Hebourd Heoding
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Pettern Dissensions
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Figure 6-16-4A MC H-1/H-46/H-53 Survey of Pilot Information Requirements Operating from Landing Zones, Segment 4A - Final Initial Approach

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Figure 6-16-48 MC H-1/H-46/H-53 Survey of Pilot Information Requirements -Operating from Landing Zones, Segment 4B - Final Close-In Approach

NAEC-MISC-91-OR019 A - Error Direction
B - Error Magnitude
C - Error Rate-of-change
D - Chance in Error Rate-Of-Change ENGINEERING COMMENTS No. Of Pilots: level
1 - Task Control
2 - Task Limit Warning
3 - Safety Limit Warning Definitions PILOT COMMENTS Roting Suggested On Pilot Questionnaire Rating Provided In Evaluation Report Rating Added By Pilot 0 4 NO. OF PILOTS AGREE/DISAGREE 222 2 G (G) (G) (G) (a) (a) (b) (b) 1 Time-To-Turn Milestone
2 Lateral Tracking Error
3 Approach Signe Tracking Error
4 Ronge Milestone
5 Obstructe Clearence
6 Relative Altitude
7 Langitudinal Haver Position 21 Ship Motion
22 Wave Off
23 Horizontal Reference
24 Hover Height
25 Closure Rote Error
26 Aircraft Flight Instruments
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MC H-1/H-46/H-53 Survey of Pilot Information Requirements -Operating from Landing Zones, Segment 5 - Hover Figure 6-16-5

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•	Pattern Dimensions	\dagger	╀	+	+	\downarrow					
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•	Delta/Charlie	H	Н	Н	Н		Arough t on we				
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=	Time-To-Turn Atlestone	+	+	\dashv	+	4					<u>.</u>
2	Lateral Tracking Error	†	+	+	+	4					_
2	Approach Nope Indexing Error	\dagger	+	+	+	\downarrow					_
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۶ م	Shir Mollon			하	+	(4)	5 5	Ship motion and horizon reference are interconnected.	9		
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Figure 6-16-6 MC H-1/H-46/H-53 Survey of Pilot Information Requirements - Operating from Landing Zones, Segment 6 - Vertical Landing

				Definitions Ration Supports On Pilot Questionnaire	suo		
) 			Type	
			٥	Rating Added By Pilot	- Task Limit Warning	A - Error Direction B - Error Magnitude	
				3 - Satet Rating Provided in Evaluation Report	y Limit Warning	C - Error Rate-of-change D - Chance in Error Rate-Of-Change	
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[<u> </u>	IdenMiy	0	Ş	Distance/fuel considerations require positive position identi-	- 110		_
2	(18) (18)	-	٩	12			
9	Base Recovery Course	I	3/2	1. We depend largely on information given to pilot as he			
$\neg \tau$	Ship Course Ambiguity		5/0	approaches his intended point of landing.			
Т	Pomen Crientonon		1/4	Need to know to decide whether to start approach on arrival.	12		_
• •	Palative Wind	_	300	3. Must have the following information: press/temp, relative wind, deck reads.			
	Sgnol Delto/Charite		3/2				 -
6	Range	-	9	These are critical for safe landing.			- T =
9	Ronge Rate		2,0				· -, -
=	Time-To-Turn Milestone			This segment is important. Must make decisions quickly. His			-
12	Lateral Tracking Error			fuel state will determine how long he can stay on station. Need	7007		† -
13	Approach Slope Tracking Error			to know Metho temp, PA, to determine if he has hover per-			 T•··
*	Ronge Ailestone			formance. Need to know Bingo airfield information - where,	,		г :
15	Obstacle Clearance			how far, do I have fuel. Winds determine how to fly pathern,	ın,		
16	Relative Altitude			what final course, etc.		(1.) Except for 4/1 Instructive	:
17	Longitudinal Hover Position			This information important to make decision early.	(2.) 2,	2, Level #1	: 1
2	Lateral Hover Position				1'2	evel #2	r 1
2	Hover Azimuth Error				1,1	1, Level f3	· 1
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31	Skew/Tension Indications						E
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	Œ	Figure 6-17-1	•	MC AV-8A Survey of Pilot Information Requirements -	virements -	,	-OR
			Operating from	Operating from LPH/LHA's, Segment 1 - Homing		-,	
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Figure 6-17-1. MC AV-8A Survey of Pilot Information Requirements - Operating from LPH/LHA's, Segment 1 - Homing

NAEC-MISC-91-OR019 A - Error Direction
B - Error Magnitude
C - Error Rate-of-change
D - Chance in Error Rate-Of-Change ENGINEERING COMMENTS No. Of More: (1.) 2, Lovel 62 2, Lovel Level
1 - Task Control
2 - Task Limit Warning
3 - Safety Limit Warning Definitions In this phase, the pilot must get some information on the ship deck status and must know his performance to determine if he should shorten the approach or BINGO, PILOT COMMENTS Rating Suggested On Pilot Questionnaire Rating Provided In Evaluation Report △ Rating Added By Pilot 0 NO. OF PILOTS AGREE/DISAGREE 5 \$\$\$\$\$\$\$\$\$ \$ -7 KJ Ş שויעו STENGS TINGS (C) (D) (C) Approach Stope Tracking Error
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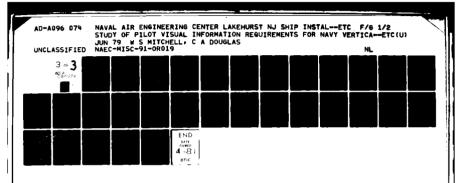
Figure 6-17-2. MC AV-8A Survey of Pilot Information Requirements -Operating from LPH/LHA's, Segment 2 - Orientation

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								Definitions		_
						0	Rating Suggested On Pilot Questionnaire	Level	986	
						•		1 - Task Control	A - Error Direction	_
					_	٥	Rating Added By Pilot	2 - Tosk Limit Warning 3 - Safety Limie Warning	B - Error Magnitude	
					-		Rating Provided In Evaluation Report	Summer than the same of	C - Error Kateriot-change D - Change in Fran Rote-Of-Change	
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~	Inbound Heading	L	T	t						T
e	Base Bacovery Course		T	F	₩		*Need to plan approach.			Т
4	Ship Course Ambiguity		T	Н						Т
5	Pattern Orlegistion		Н	Ħ			ofhis section is strictly flying instruments! You've already	stready		Т
9	Pattern Dimensions		Н		J] 5/0		made the decision to start the approach. You've determined	etermined		Τ
4	Relative Wind			Ħ	o/s (i)		what your pattern is and what your BRC is. You've determined	determined		Ţ
8	Signal Delta/Charite		Γ	f	\$\$ [0]		what your level of altitude would be, etc.			Ţ
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2	Relative Altitude		Н	Н						
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8	Lateral Hover Position		Η	Н						ļ
6	Hover Azimuth Error		Г	Н						
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જ	Closure Rate Error			Н						
8	Aircraft Flight Instruments	Cell to lite	υ	Н	5/0					· 1
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8	VERTIEP Load Data		-	Н						. 7
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32	Sled Status		+	+						-
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Figure 6-17-3. MC AV-8A Survey of Pilot Information Requirements - Operating from LPH/LHA's, Segment 3 - Initial Approach



NAEC-MISC-91-OR019 D - Chance in Error Rate - Of-Change B - Error Magnitude C - Error Rate-of-change ENGINEERING COMMENIS A - Error Direction No. Of Pilots: 2, Level #28 Speed/Long" (3,) Except for 4/1 Vertical (1.) 2, Lovel #1 1, Level 12 (2.) 2, Lovel 11 2, Lovel #1 1 - Task Control 2 - Task Limit Warning 3 - Safety Limit Warning Definitions visual. This partion of the azimuth and glide slape information is very critical. Range is critical because without CCA you don't know when to go to 40 nozzle. Need to know range for •This segment is a transition segment in that you will go from directly instrument flying to both instruments and ottempt to go During this segment, must have something to cue distance and looking for visual reference for hover. Level Physical to know exact altitude because 400's statisht in leaves little ground clearance. Also, it affects distance and consequently transition point at which glide slope intercepted Need to know if it changes much, Once in segment 48, PILOT COMMENTS Rating Suggested On Pilot Questionnaire Rating Provided In Evaluation Report putting gear and nazzles down. NOTE: segment depiction. Rating Added By Pilot AV-8 can't turn. 4 AGREE/DISAGREE NO. OF PILOTS 6 2 ş នុ 35 3/2 \$ 25 **WINGS** ε ω 2 E Jeon pe Q Range Rote
Time-To-Turn Milestone
Lateral Tracking Error
Approach Slope Tracking Error Longitudinal Hover Position Lateral Hover Position Aircraft Flight Instruments ecial Info. Req'd. Cat. Skew/Tension Indications REQUIREMENT CATEGORIES Bose Recovery Course Ship Course Ambiguity Pathern Orientation **INFORMATION** Signal Delta/Charite Horizontal Reference Obstacle Clearance Hover Azimuth Error VERTREP Load Date Aircraft Separation Pattern Dimensions Closure Rate Error 16 Relative Altitude Inbound Heading Range Milestone Density Altitude Relative Wind Deck Status Ship Motion Hover Height HIFE Status Sled Status Move Off Identity

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Figure 6-17-4A. MC AV-8A Survey of Pilot Information Requirements -Operating from LPH/LHA's, Segment 4A - Final Initial Approach

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								Derions	
						0	Rating Suggested On Pilot Questionnaire Level	Level	Type A - Free Dissessor
						4	A Rating Added By Pilot 2 - 10	2 - Task Limit Warning 3 - Safety Limit Warning	8 - Error Magnitude
•				PATINGS	 9		Rating Provided In Evaluation Report		D - Chance in Error Rate-Of-Change
INFORMATION		1	100		4/12			CELLY.	No. Of Pilots: 5
CATEGORIES		PAOL	I VO VI PARA TO THE PARA TO TH	12	2	NO. OF PILOTS AGREE/DISAGREE	PILOT COMMENTS	_	ENGINEERING COMMENTS
Identity	l			\vdash					
Inbound Heading				H					
Base Recovery Course		Ц		Θ	1/7		Full visual stage. This phase picking up the ball is very im-	-6	
Ship Course Ambiguity				Н			portant I The pilot scan goes completely outside so you need a	ope	
Pattern Orientation	H	Ц		Н			very good glide slope and azimuth cue. You need a cue at I	1	
Pattern Dimensions	7			-	╛		mile so that you can go the hover stop. You must know if you	you	
Relative Wind				10	3/2		have a ready deck and wave off cue is mandatory. You need a	oped	
Signal Delta/Charlie				Н			LSO (Landing Safety Officer) and he has to have a radio as a	2 2	
				Н			back-up for safety reasons. Segment 48 is primarily visual		
Range Rate		_		_			approach criteria in AV-8A. Range rates and relative clear-	- <u>-</u> -	
Time-To-Turn Milestone	-			H			ance are very important the controlled primarily through total	lotol	
Lateral Tracking Error		20		Н	1/1		VFR outside the cockpit scan.		
Approach Slope Tracking Error			20	\dashv	2/0				
Ronge Milestone	7			0	\$		12. Critical if line up lights are on angle deck. AV-8A		
Obstacle Clearance				Ø	-/2	(1.)	can't turn @ 30-90 knots.	(1.)	1, Level #2
Relative Alithude	-			W	<u>-</u>			-	, Level #3
Longitudinal Hover Position	-			-				(2,)	Except for 4/1 Speed/Long'I.
Lateral Hover Position				\vdash					
Hover Azimuth Error									
Deck Status	Н				3/2		"Need to decide whether to wave off, Must be done in this seg-	. seg-	
Ship Motion				Н		 	ment.		
Wave Off				ဇ	L				
Horizonkal Reference	۴	(10 ftc)		L	L				
Hover Height				Н					
Closure Rate Error		(E)	_	L	3/2		"Must know because: 1) if too fast going into segment, 5 must) or i	
Aircroff Flight Instruments		ວດ ແນງ ວັດ	ρij	Н	2/0	(2,)	wave-off; 2) If too slow and using water injection, could run	T.C.	
ipecial Info. Req'd. Cat.							out of water and couldn't hover.		
Density Altitude				H					
VERTIREP Load Data	\sqcap	Н		H			26.* Must use to ensure sufficient closure.		
Aircraft Separation		H		\dashv					
HIFR Status	+	7	1	\dashv					
Skew/Tension Indications	+	1	1	+	1				
Sled Status	_	_	_	_	-		-	•	

Figure 6-17-4B. MC AV-8A Survey of Pilot Information Requirements - Operating from LPH/LHA's, Segment 4B - Final Close-In Approach

NAEC-MISC-91-OR019 B - Error Magnitude C - Error Rate-of-change D - Chance in Error Rate-Of-Change ENGINEERING COMMENTS A - Error Direction No. Of Pilots: 1 - Task Control 2 - Task Limit Warning 3 - Safety Limit Warning Definitions Orection is most important. This phase is strictly visual. You need a good visual cue for altitude and line-up and fue JAFT pasition. The pilot scan is outside totally. Landing site information. off you level off abruptly, too high, you'll lose sight of line-up lights plus either side of floodlighted ship. 25. • If closing too fast, you must have large flare. With AVBA cockpit, this means losing sight of line-up lights and deck and VFR outside cockpit scan only - no HUD or other instrumenta-tion presently available can substitute for seeing position and drift. PILOT COMMENTS Rating Suggested On Pilot Questionnaire Rating Provided In Evaluation Report Couldn't perform task if deck fouled, tion is the same requirement. possibly other visual cues. Rating Added By Pilot 4 AGREE/DISAGREE NO. OF PILOTS Ş ς 2 2222 222222 MINGS Jest Jos 30 30 34 39 G 28 (28 (3) (3) (4) (a) (a) (b) 20 20 20 Approach Slope Tracking Error Longitudinal Hover Position Lateral Hover Position Aircraft Flight Instruments ecial Info. Req'd. Cat. Skew/Tension Indications REQUIREMENT CATEGORIES Time-To-Turn Milestone **INFORMATION** Bose Becovery Course Ship Course Ambiguity Lateral Tracking Error Signal Delta/Charlie Horizontal Reference Pattern Orientation Obstacle Clearance Hover Azimuth Error VERTIEP Load Data Aircraft Separation Pothern Dimensions Closure Rate Error Relative Altitude Inbound Heading Range Milestone Density Altitude Relative Wind Hover Height Deck Status Ship Motion HIFE Status Wave Off

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Figure 6-17-5. MC AV-8A Survey of Pilot Information Requirements -Operating from LPH/LHA's, Segment 5 - Hover

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NAEC-MISC-91-OR019 A - Error Direction
B - Error Magnitude
C - Error Rate-of-change
D - Chance in Error Rate-Of-Change ENGINEERING COMMENTS No. Of Pilots: Level 1 - Tosk Control 2 - Task Limit Warning 3 - Safety Limit Warning acad cust so that you can haver. The same cust analy to both the help and the AVBA. You need to know what your sink rate is once you start down. You need some way of determining that you are cleared to land by the LSO. Definitions For landing the pilot references are totally outside. You need PILOT COMMENTS Rating Suggested On Pilot Questionnaire Rating Provided in Evaluation Report Rating Addud By Pilot 0 4 NO. OF PILOTS AGREE/DISAGREE \$85 5 2 S \$ 5 MINGS म जाना का क क कि कि क <u>9</u> 9 क कि क 9 自 9 Range
10 Range Bate
11 Time-To-Turn Milestone
12 Lateral Tracking Error
13 Approach Stope Tracking Error
14 Range Milestone
15 Obstocia Ciserone
16 Reletive Alfithuse 17 Long/hulinal Hover Position
18 Lateral Hover Position
19 Hover Azimuth Error
20 Deck Stehs
21 Ship Motion Aircraft Separation
HIFE Status
Skew/Tension Indications Aircraft Flight Instruments INFORMATION REQUIREMENT CATEGORIES Base Recovery Course Ship Course Ambiguity Pattern Orientation 22 Wave Off 23 Horizontal Reference 24 Hover Height scial Info. Reg'd. Cat. 8 Signal Delta/Charlie 27 Density Airitude
28 VERTIEF Load Data Pottern Dimensions Closure Rate Error Inbound Heading Belative Wind Sled Status

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Figure 6-17-6. MC AV-8A Survey of Pilot Information Requirements -Operating from LPH/LHA's, Segment 6 - Vertical Landing

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							Definitions			_
						_	Rating Suggested On Pilot Questionnaire	•		_
)			Type Your Discussion	
						4	Roting Added By Pilot		B - Error Magnitude	
							3 - Safety Limit Warning		C - Error Rate-of-change	
				•			Rating Provided In Evaluation Report	Ū- <u>a</u>	D - Chance in Error Rate-Of-Change	
	INFORMATION	`	\		; ``	- con				٦
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		2	\sim		\sim		PILOT COMMENTS	ENGINE	ENGINEERING COMMENTS	
_	Identity	_		L	<u> </u>	· →	3. "If it is the only place you can land, AV-8A operations			γ.
~	Inbound Heading	0	-	L	L	1/4	depend largely on info given to the pilot as he approaches			1
<u>س</u>	Base Becovery Course	H	Н	Н	9	3/2	his intended point of landing. Must have following info:			Т
*	Н		Н	Н	0		press/temp, relative wind, deck ready.			_
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7	Belative Wind	-	4	4	0					_
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2	-		Н	Ц			·These items are critical for safe landing.			
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15	Н	H	Н	Н	Ц					
13	\dashv	Н	Н	Н	Ц					
=	\vdash		Н	Ц	Ц			(1.) Except for 4	Except for 4/1 instructive	
12	Н	Н	Н	Н	Ц					
2	Relative Altitude	\dashv	Н	Ц	Ц					
-	Longitudinal Hover Position	Н	Н	Н	Ц		•			_
=	1 Lateral Hover Position	Н	Н	Н	Ц					•
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~ t	-	\dagger	+	+	4					-,
*	+	+	+	+	4					7
8	+	+	+	+	4					_
•	-+	+	+	4	4					_
2	Closure Rate Error	-	+	4	_		•			1
8	Aircraft Flight Instruments		칅	ᅥ	₽	3,0 (1.)				_
	8.									_
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គ	_	+	\dashv	4	4					_
32	Sled Status	-	\dashv		4					
										_

Figure 6-18-1. MC AV-8A Survey of Pilot Information Requirements - Operating from Tactical Sites, Segment 1 - Homing

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INFORMATION RECUIREMENT 1 Identity 2 Internal House Rolling 5 Patient Dimensions 6 Patient Dimensions 6 Patient Dimensions 1 Internal Totaling Broad 1 Internal Totaling Broad 1 Internal Totaling Broad 1 Internal Totaling Broad 1 Internal Totaling Broad 1 Internal Totaling Broad 1 Internal Totaling Broad 1 Internal Totaling Broad 1 Internal Totaling Broad 1 Internal Totaling Broad 1 Internal Totaling Broad 1 Internal Totaling Broad 1 Internal Totaling Broad 1 Internal Totaling Broad 1 Internal Totaling Broad 1 Internal Totaling Broad 1 Internal Hower Position 1 Internal Hower Position 2 Wowe Off 2 How salaring Broad 2 How salaring Broad 2 How salaring Broad 2 How salaring Broad 3 Her Special Mich Red & Cer. 3 Alercial Separation 3 Alercial Separation 3 Her Special How Red Food Dota 3 Her Special How Red Food Dota 4 How Red & Cer. 5 Alercial Separation 3 Her Special How Red Food Dota 4 How Red & Cer. 5 Alercial How Red & Cer. 5 Alercial Separation 3 Her Special How Red & Cer. 5 Alercial Separation 5 Her Special How Red & Cer. 5 Alercial Separation 5 Her Special How Red & Cer.							_			ı	_
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I MARCHANTION									3 - Scient Limit Worming	C - Error Kale-of-change	
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22 Wove Off 23 Horizontal Reference 24 Hove Height Reference 25 Closure Rate Error 26 Aircraft Flight Instruments (IC 18) (IC 18) 27 Density Altitude 28 VERTIRE Load Deto 29 Aircraft Separation 30 HIPE Stories Indications	-+	ip Motion	+	4	ightharpoonup	+					7
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24 Hover Height 25 Cloude Blate Error 26 Aircraft Flate Instruments [1] [1] [1] 27 Density Aliftude 27 Density Aliftude 29 Aircraft Separation 29 Aircraft Separation 30 Aircraft Separation 31 Steam Instrument In	-	rizontal Reference	+	4	1	7					Т
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Figure 6-18-2. MC AV-8A Survey of Pilot Information Requirements - Operating from Tactical Sites, Segment 2 - Orientation

NAEC-MISC-91-OR019

Definitions

Figure 6-18-3. MC AV-8A Survey of Pilot Information Requirements - Operating from Tactical Sites, Segment 3 - Initial Approach

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Figure 6-18-4A. MC AV-8A Survey of Pilot Information Requirements - Operating from Tactical Sites, Segment 4A - Final Initial Approach

NAEC-MISC-91-ORO'9 8 - Error Magnitude C - Error Rate-of-change D - Chance in Error Rate-Of-Change ENGINEERING COMMENTS No. Of Pilots: A - Error Direction Level
1 - Task Control
2 - Task Limit Warning
3 - Safety Limit Warning Definitions Citical to decelerate approach from other than streight into wind. PILOT COMMENTS Rating Suggested On Pilat Questionnaire Rating Provided In Evaluation Report Need to clear approach obstacles. A Rating Added By Pilot NO. OF PILOTS AGREE/DISAGREE 22 5 \$ 322 \$ 3 EATINGS 0 0 9 00 (0) 10 (0) 30 10 Range Rate
11 Time-To-Tan Milestone
12 Lateral Tracking Error
13 Approach Slope Tracking Error
14 Range Milestone
15 Chattorie Clearance
16 Relative Altitude
17 Langitudinal Hover Position
18 Lateral Hover Position 24 Hover Height
25 Closure Rate Error
26 Aircroff Flight Instruments
Special Info. Req-d. Cat.
27 Demandy Alithade
28 VERTREF Load Date
29 Aircraft Separation
30 HIR Status
31 Stew/Tension Indications REQUIREMENT CATEGORIES Inbound Heading
Bose Recovery Course
Ship Course Ambiguity
Pothern Orientation Signal Delta/Charlie Horizontal Reference Pathern Dimensions Relative Wind Hover Azimuth Error 20 Deck Stehus 21 Ship Motion Wave Off Sled Status TEM

Figure 6-18-4B. MC AV-8A Survey of Pilot Information Requirements -Operating from Tactical Sites, Segment 4B - Final Close-In Approach

NAEC-MISC-91-OR019 A - Erra Direction
8 - Erra Magnitude
C - Errar Rote-of-change
D - Chance in Errar Rate-Of-Change ENGINEERING COMMENTS No. Of Priots: Level
1 - Task Control
2 - Task Limit Warning
3 - Safety Limit Warning Definitions PILOT COMMENTS Rating Suggested On Pilot Questionnaire Rating Provided In Evaluation Report Rating Added By Pilot Looks good. ◁ NO. OF PILOTS AGREE/DISAGREE \$ \$ \$\$\$\$ 52255 \$ RATINGS <u>ල</u> न्त्र विश्व विश्व (a) (a) (a) 8 12 Time-To-Turn Milestone
Lateral Tracking Error
Approach Stope Tracking Error
Range Milestone
Obstocle Clearance
Relative Altitude
Longitudinal Hover Position
Lateral Hover Position Closure Rate Error Aircraft Flight Instruments Special Info. Req'd. Cat. Skew/Tension Indications INFORMATION REQUIREMENT CATEGORIES Base Recovery Course Ship Course Ambiguity Pattern Orientation Pattern Dimensions Relative Wind Signal Delta/Charlie Wave Off Horizontal Reference 19 Hover Azimuth Error 20 Deck Status VERTREP Load Data Density Altitude Aircraft Separation Inbound Heading Ship Motion Hover Height Range Rate HIFR Shatus Sled Status Identity Ronge

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Figure 6-18-5. MC AV-8A Survey of Pilot Information Requirements -Operating from Tactical Sites, Segment 5 - Hover

NAEC-MISC-91-OR019 Type
A - Error Direction
B - Error Augnitude
C - Error Rote-of-chonge
D - Chonce in Error Rote-Of-Chonge ENGINEERING COMMENTS No. Of Pilots: Level
1 - Task Control
2 - Task Limit Warning
3 - Sofety Limit Warning Definitions PILOT COMMENTS Rating Suggested On Pilat Questionnaire Rating Provided In Evaluation Report Rating Added By Pilot 4 AGREE/DISAGREE 일본 3 38 ξ Soll See 9 का टबा टबा टब ३० टबाटन वि र्ग्ड रहे रहे 30 Lateral Tracking Error
Approach Slope Tracking Error
Range Milestone
Obstacle Clearance
Relative Altitude
Longitudinal Hover Position 22 Wove Off
23 Horizontal Reference
24 Hover Height
25 Closure Rate Error
26 Aircroff Flight Instruments
Special Info. Req'd. Cot. Skew/Tension indications Sled Status INFORMATION REQUIREMENT CATEGORIES Ship Course Ambiguity
Pattern Orlentation
Pattern Dimensions
Relative Wind
Signal Delta/Chartie Time-To-Turn Milestone Identity Inbound Heading Base Recovery Course Lateral Hover Position Hover Azimuth Error VERTREP Load Data Aircraft Separation HIFR Status Density Altitude Deck Status Ship Motion Range Rate Ronge

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Figure 6-18-6. MC AV-8A Survey of Pilot Information Requirements Operating from Tactical Sites, Segment 6 - Vertical Landing

SECTION VII. PILOT STATEMENTS

The pilot interview questionnaire asked 98 participating pilots three questions concerning visual landing aids. The responses to these questions are tabulated in this section by the branch of service and aircraft type.

A. Visual cue sources during night operations. (What informal cue sources do you use in night ops to obtain essential info: gimmicks like discrete alignment of ship structural elements, etc.?)

H-1, Marine

Primarily, aircraft instruments.

Mast light is 175' above sea level on LPH. It should not be level with horizon until after the 90° position.

Cue sources on final: ship's tower lights, deck lights, spot line-up lights, and finally, LSE lights.

Cues which I use are the landing signal enlisted and light reflected off the landing spot. The lighting arrangement on the LPH is poor. The 45° line-up line on a LPD is much longer and much brighter with more lights on the line-up.

I use the bridge as a visual cue and the LSE.

Cues: Few, if any, discrete cues are used until segment 4B when the flight deck becomes the visual horizon and this cue is used until segment 6.

Depends on spot.

Bridge height is good for crossing the deck.

H-2, Navy

Night operations conducted prior to inclusion of VLA equipment. All approaches were self-contained from cockpit info (e.g., rad. alt., VSI, TACAN, etc.). Co-pilot would provide advisory info and advise when pre-briefed limitations were exceeded.

Ship's NAV lighting provides the only cues beyond actual VLA/flight deck lighting for general orientation around the ship. Beyond general outline of superstructure, visibility of the ship at night is nil.

Use co-pilot to give vocal A/S, altitude info during 4A, 4B, and 5 phase of flight.

Cue use for line-up lights/centerline.

Snip structure elements in line-up - Motion of high and low objects on deck or hangar.

Informal cues - lighting of deck - wake of ship - mast lights and running lights; all to determine or picture in my mind where the ship is relative to me. Combined with GSI information and cockpit information to effect a transition to a hover over the deck.

During phase 4, I utilize drop-line and the strobes to set myself up for line-up. The two give me excellent visual cues as to relative position of A/C to ship.

Proper lighting (are all lights on, how bright). Activity on flight deck (LSE or LSO visible). Ship pitch and roll characteristics (movement of key lights and side lights).

I rely on my co-pilot for line-up, height and closure speed as a back-up for my own visual cues. If the co-pilot is giving timely information, the approach is not too difficult until crossing the deck. My biggest assist in centering the aircraft over the deck is the center circle lights. I have used the GSI one time and it appeared to be a most invaluable system. I need more work with it to become proficient.

Have never flown GSI approach. Presently use ship lighting, deck obstacles, i.e., hangar, gun mounts, etc.

Hover with hangar top at eye level. Keep all control inputs positive to keep from "flying the ship."

Outline of hangar and hangar rail on flight deck.

Ships wake, surrounding water and size of LSE in close.

H-46, Navy

Hangar top (AFS, AOE) lights on hangar.

Use different light alignments and use height of certain items on superstructure in front of me for altitude.

Night ops - Essential information. Mast and range light of ship when in appropriate quadrants; also running lights. In close, the size of super-structure tells something of distance to ship and changes give information on closure rate.

The closure rate between aircraft and ship is almost impossible to discern or find at night. There are virtually no cues available to aid in flying this closure rate. Perhaps only the slight difference and relative movement in the flight deck lights. A system that could give relative closure rate for the last $\frac{1}{2}$ mile to ship would be very helpful. There are also no good cues to establish altitude above the water during the final approach. The only real help is the radar altimeter in the aircraft itself and little as far as a visual reference. I have almost put the helo in the water for lack of any visual reference or to altitude on final.

Use alignment lights, spacing of lights (vert. dist.) lighting scheme (position) and brightness (hovering distance).

Top of hangar on AFS. Main deck lights. (Red lens in port security lights) shining down at water provides depth of vision cue.

- a. Mast head & range lite relative position to determine ships head and direction of travel.
- b. Silhouette of ships structure (particularly VERTREP tower).

 Sometimes you can use moon or an alongside ship's lights to outline home plate.
- c. Ship, particularly AFS, will sometimes turn on PIL red lights along fork-truck passageways and bridge giving good outline of ship w/o destroying night vision.

Night visual cues include, but not limited to:

- 1) VERTREP deck lighting (red)
- 2) Deck edge lights
- 3) Line-up lights

- 4) Stern lights
- 5) LSE in light suit
- 6) Raising hangar doors approx. 1 ft. w/white back lighting for simulated deck horizon/visual reference
- 7) Ship running lights

H-46, Marine

Yellow gear on flight deck can be used for relative motion in segment 5 since it reflects the red moon beams.

At night I stay on instruments until 90° approach position for primary altitude reference. I prefer to enter "D" first to ascertain ships heading, which end is which, and to note deck lighting. At 90° position, I ascertain closure rate by rate lights on ship separate. Watch A/C airspeed and rate of descent which I attempt to stabilize, and attempt to sight linesman or object I know size and then can interpret closure rate.

LPH Guam has a quantum leap above other LPH's in fleet with new lighting systems. Hangar and 01 & 02 level lighting; 03 level being flight deck.

For determining position of landing spots on ship (LPH), the use of the ships superstructure. Also the lights on the ship.

Race Track pattern using ships BRC fly downwind reciprocal man on left seat guide you with VFR vectors as to heading and line up you are on gages til after 180° .

Crew coordination pilot in control on instrument for upwind, turn and downwind. Co-pilot is using visual indications and monitoring engine/transmission gauges. At 180° position pilot at controls switches from gauges to visual and other pilot monitors airspeed and altitude and cockpit indications. Visual approach references are ship's lights and outline.

H-53, Marine

Once established downwind, utilize hangar deck lights if door is open to pick up alt. reference and closure rate. Current LPH lighting does not give sufficient reference to determine (1) closure rate, (2) altitude or even see the deck.

Primary instruments used by me are the attitude gyro, airspeed indicator, VSI and radar altimeter. The other instruments are glanced at but unless something unusual is noted, I don't pay much attention to them. Outside sign is included to set up for the pattern and my relative position to the ship. Most visual cues occur on final and over the deck edge.

AV-8A, Marine

Ship's island.

On a fixed wing carrier, we (AV-8) used the round down and the top of the "Cherry Picker" crane to the right of the wires. The crane was good for hover altitude and positioning abeam the intended point of landing. The round down passing under the nose as cue for disregarding the ball for glide slope and transitioning to level off watching crane and line up. Some pilots used rotating clear deck recovery light by Pri-Fly as altitude reference.

B. Adequacy of present VLA suits. (How do you feel about the adequacy of present VLA suits with respect to all potential landing/hovering/HIFR, etc. sites?)

H-1, Marine

Satisfactory

Bridge height is good for crossing the deck.

Good on ships where used.

VLA suits are too dim for what I consider adequate references. This comment must be tempered with the fact that moon beams and other lights were being used, therefore diminishing the VLA light source.

On the LPH & LPD, the only VLA are the LSE and the 45° line up lights.

On the LPH, the present system works but it's never utilized the way it was designed to be used; i.e., the 45° lights on the spot (lateral & approach error) work fine, but the system is seldom up (six months at sea I never shot a night approach with any angle lights). The LSE and his lighted suit offer a hover altitude and drift reference if the suit is bright enough to see.

Very good.

Deck lighting is generally inadequate. Alignment type lighting in particular needs improvement. LSE light suits are generally poor, either too dim or intermittent.

H-2, Navy

It appears we remain tied to VLA that originate at ship of absolute no value in conditions of low visibility. Need to develop a "needles" system similar to CV fixed wing approach system.

Present VLA is generally adequate for night landings; however, HIFR/hover operations are limited due to orientation of VLA mainly for actual landings.

VLA with respect to FF with VGSI very good; however, all ships not standardized (have different equipment installed), so approach techniques necessarily different.

Very difficult without horizon reference for vertigo control. Range is needed. More stable GSLI needed on 1052 Class.

Not adequate for any sea-state greater than 2-3.

Much prefer the packages on Canadian and British Frigates. We could possibly learn from their successes.

SGSI excellent at this time. With tailwind at night, however, closure rate to ship is difficult to discern and corresponding GSI info. can become more difficult to properly evaluate.

Not adequate for landing phase during moderate to high sea states.

The VLA package on the 1052's is good. The GSI will greatly enhance the pilot's ability to make safe night conditions.

Something (GSI is always better than nothing). Have heard good things about GSI and most seem to feel it is adequate for this demanding environment.

Hangar door face lighting should be standardized white. Red lighting gives no depth perception.

GSI has greatly improved approach phase, especially with respect to altitude information. Still is a necessity for closure rate error information; must rely now on relative size of ship/landing area with no other cues or aids.

H-46, Navy

Totally inadequate on small AE decks I dealt with.

Present VLA package aboard service force ships is very inadequate. This is also true of most amphibs. The lights and associated gear are basically designed for a VFR night w/a horizon. The transition phase from IFR flying to visual contact with ship is unsatisfactory since the cues received from ships VLA are not as complete as IFR instruments in the cockpit; therefore, the pilot is not able to fly to the limits of safe operations once the transition to visual on current VLA package aboard Service Force ships and amphibs.

Not fooling with any of these for ships other than the hull.

Suits are cumbersome and not bright enough.*

Very adequate.*

I have never seen VLA systems.

VLA suits, when operable, are excellent references for night operations, providing both clarity for signals and an excellent "close-in" visual reference.*

H-46, Marine

VLA suits are useful for determining what signal LSE thinks he is giving (no substitute for well trained LSE).

Would like to see uniform lighting of type ships to aid in identification and the continued use of lighted LSE suits to aid in determining closure rate when close to landing. Don't illuminate large areas in red light as with its long wave length, it impedes focus and therefore depth perception.

Standardization of color of lights for VLA is poor; land versus sea.

Present illumination of deck and obstacles is inadequate. Moon beam intensity is too intense when turned up to provide adequate lighting.

H-53, Marine

Current VLA unsatisfactory. LPH lights (red) cannot give pilot good visual reference. LSE suit lights weak and visible only $\frac{1}{4}$ mile or less.*

VLA suits are very inadequate. Too dim! Many nights the LSE can't be seen 'til within $\frac{1}{2}$ mile.

^{*} It appears that the term "VLA suit" used in the pilot questionnaire (meaning the complete VLA system) was interpreted here as referring to the LSE suit.

AV-8A, Marine

The mirror/lens is a good system, especially if it's rolled or moved back to allow you to come to a hover w/a centered ball. Line up lights are still essential and a radar altimeter. This method was many times better than having to transition off the ball.

C. VLA recommendations. (What are your VLA recommendations?)

H-1, Marine

I would like to see an LPH equipped with VLA in the following manner:

1) equip LPH/LPD's with a visible radar (capability that exists today is inadequate for night operations; 2) equip spots 2, 3, 4, 5, & 7 with VLA at deck edge; 3) the VLA for each spot would be turned on just prior to A/C reaching the 90° position, while on final (LPH) A/C would pick up VLA for final visual approach to spot; 4) LSE would be picked up just prior to A/C crossing deck edge; 5) signals from LSE used to land. However, and this may be academic, the radar/TACAN capability of today's LPH/LPD's are not adequate to handle night operations even if VLA's were available; they are not reliable.

Brighten lights.

Need to develop a "needles" system similar to CV fixed wing approach system. We need an "ILS" system.

The LPD & LPH could use some type of GAIL system. The radar and NAVAIDS on these ships are probably the worst in the Navy.

The LPH with a glide slope indicator would be wonderful. The LPD would be much easier to equip though.

Something maintainable by Marines.

Should have lites on 45° bearing vice; one on each end of it.

H-2, Navy

Improved VLA as proposed in presentation appears to satisfy the needs of helicopter operations abound non-aviation ships under present circumstances. However, with the inclusion of MK III and the 4 hr. missions under increased sea states/reduced meteorological conditions, the pilot work load will be appreciably increased. The fatigue factor created by the stressful conditions

of flying at low altitudes under IMC for prolonged periods will most probably restrict (reduce) the pilot's ability to perform at peak efficiency. Coupled with further complications (sea state 5+) A/C systems degradation, EMCON, etc., and the stage is set against the aircrew. Therefore, the emphasis should not be on visual cues but rather on an automated landing system. Monies obligated for sophisticated VLA packages will have limited improvement if the pilot's response time has been greatly reduced. EMCON poses a special restriction on locating a single ship that has been steaming independently for several hours. Would it not be more beneficial to enhance the aircrew's capability to return unaided through such means as an inertial navigation system capable of analyzing and compensating for existing winds? Once overhead the ship, a laser guided (?) automatic approach and landing would be of substantial benefit to a tired aircrew.

It is becoming an ever popular belief among safety personnel that accidents previously attributed to "pilot error" may have been the result of a pilot subjected to a workload beyond his capabilities (beyond anyone's capabilities). This is what I foresee as the future for LAMPS pilots.

However, until the requirement is generated by proper authority and contractors are tasked to develop the equipment to lessen the workload, the VLA package is the next best thing.

We need an "ILS" system.

One primary addition to VLA which would aid landings on rolling decks, plus aid HIFR/hover operations, would be a stabilized horizon bar. This could be indexed to provide an indication of magnitude of ship's motion.

Ship's heave (vertical and lateral motion) is a considerable problem in sea state 3 and above. Maintaining a steady hover over landing site very difficult. Horizon presentation and/or lateral and vertical direction cues should be available.

Possible radar link to A/C to indicate range to landing area. Need cockpit indication for out of sight conditions indicating deck status. Need rate of closure to landing area from about $1/\frac{1}{2}$ mile into landing area.

Require an artificial horizon (lighted for night operations). Pitch indicator (ship), and rate of closure system – to identify excessive rates at night.

Recommend change color scheme of present GSI to conform to standard color scheme, i.e., green/amber/red.

Install SGSI on all aviation facility ships, and restrict night operations on those ships, and restrict night operations on those ships that do not have it installed.

Current GSI so small it's difficult to find (and sometimes distinguish colors) at distance, then it is too bright in close. Because it's so small, horizon information is useless – recommend wider GSI lens for these reasons.

H-46, Navy

Some type of visual cockpit display that allows the pilot to fly the final approach as if he were in a simulator (T,V, screen type). This could also be coupled to the flight controls for automatic approaches.

A glide slope indicator (visual) that compensates for ship pitch and roll and a relative wind indicator in the A/C. I do not feel that VERTREP could ever be done completely on instruments with the H-46 due to no doppler and head programming for level fuselage. Swinging loads extremely high power settings also add to the problem.

Recommendations: Upgrade navigation systems on all ships, i.e., TACAN and LF. GSI should be mandatory for night certification, either Level 1 or II. Instrument approaches need to be certified aboard each ship and require qualified people on board for control if operating helos at night.

Main deck lighting as indicated in #1 above. Scoreboard type of display of information, i.e., load weight, wind, destination, heading, BRC, etc.

Hurry!!

H-46, Marine

VLA - we need something similar to CVA lens set-up, perhaps VLA approach to pt. abeam spot 7 on LPH the reposition up port side to specific spot.

If information in segments which is instructive changes its level, should be raised to allow pilot to change.

For LPH/LHA/Aviation facility ships/Non-aviation facility ships should use white floodlights for the deck areas as is now the case on CV's. LPH/LHA/LPD/LSD's should have the landing TEE's/crosses lighted completely in a color contrasting the white floods. The use of drop lights on LPH/LHA/LSD/LPD would greatly facilitate line up and descent control during the final phases of landing.

Putting deck lights in series on the 1 and 45° line 1 on LPH deck will help with line.

Possible use of a VASI system for Approach Lighting.

Visual Landing Aids on LPD & LPH need visual glide slope, so can see night approach 200 feet +1 mile. Also lighting for 45° on spot line up. Drop-line lights on side of spot.

Improved ship lighting for better references.

Possible use of a VASI system for approach lighting.

Drop lights on side of ship and end.

Wide angle glide slope indicator set up on pri-fly so you arrive at 50 ft. over spot 5. Transition from WAGSI to spot is sometimes difficult.

H-53, Marine

Recommend that LPH on aviation facility ships convert to white lights, and make them work. Lighting on USS GUAM is what ships need.

Many of the VLA's on LPH's don't work. They aren't properly maintained. The red lighting is very poor. Almost any change in the lighting would be an improvement.

Aviation ships need a good, safe, and simple system for visual approach under stated conditions. This would increase the safety margin. Paramount though, the system must be simple for quick assimilation, and correction can be immediately taken by the pilot.

AV-8A, Marine

I believe that a meatball type system with lineup lights and drop-lights down the side of the ship with some type of range warning system (VASI-type?) to let the pilot know when to put the gear down, then the nozzles, would be ideal.

The following is a general statement from a Marine H-46 pilot which does not answer any of the three questions specifically, but is considered relevant and therefore included in this section.

Initial critical info is location, status, range, & movement of carrier; you must intercept ship to land. With multiple A/C ops, aircraft/flight separation, flight deck status, & fuel availability are critical. The basic approach is on instruments (relative wind, altitude readout, A/C separation, & deck status are critical here). At the abeam position (must be identifiable) the base turn is commenced considering relative wind and ship movement. At the 90 rate of closure, glide slope, relative wind, & visual intercept angle become critical. As the A/C crosses flight deck the closure rate, intercept angle, air speed, & descent rate must be under positive control & minimized. Visual reference is required — no horizon reference is necessary. The vertical descent to the flight deck is critical in relation to obstacle clearance, descent rate, visual reference with flight deck, & zero relative movement during descent.

SECTION VIII. TYPICAL VISUAL LANDING AID CONFIGURATIONS

This section provides the typical VLA configurations for LPH/LHA's (Figure 8-1), air capable ships (Figure 8-2), and 600' tactical sites (Figure 8-3). The VLA briefly described in the drawing consists of the following components:

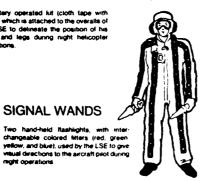
- 1. Homing beacon
- 2. Rotary beacon signal system
- 3. Stabilized glide slope indicator
- 4. Wave-off/cut lights
- 5. Overhead floodlights
- 6. AV-8 STOL line lights
- 7. Deck surface floodlights
- 8. AV-8 nozzle rotation lights
- 9. Vertical drop-line lights
- 10. Portable helicopter landing spotlight
- 11. Helicopter landing spotlight
- 12. Deck edge lights
- 13. Landing/VERTREP line-up lights
- 14. Deck status lights
- 15. Hangar wash lights
- 16. HIFR heading lights
- 17. Extended line-up lights
- 18. Maintenance floodlights
- 19. Threshold lights
- 20. Strobe lights
- 21. Approach lights
- 22. Centerline lights
- 23. Runway lights
- 24. Rotation lights
- 25. Taxiway lights
- 26. Obstruction lights
- 27. Wind cone assembly
- 28. Landing signal light kit
- 29. Signal wands

The typical VLA configuration for 600' tactical sites is more elaborate than the small tactical site evaluated in the analysis.

LANDING SIGNAL LIGHT KIT (WHITE)

A battery operated kit (cloth tape with lights) which is attached to the overalls of the LSE to delineate the position of his arms and legs during night helicopter

SIGNAL WANDS



HOMING SEACON LIGHT (WHITE)

Mounted high in the air SPS-10F antenna platform to provide the neicopter pilot a visual guide iffaaming amee light beaml for



ROTARY BEACON

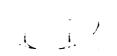
Provides visual color lights (either amber, or green) to indicate to the pilot deck crew the status of the flight dec

GREEN LIGHT - A clear deck situal exists (landings and take-off are allow

RED LIGHT - A foul deck situation of flandings and take-off are prohibited

DECK EDGE LIGHTS (ELJE)

The purpose of these globe-type edge lights is to outline the edge of the flight deck.



HELICOPTER LANDING SPOT LIGHT

Beven white guide lights and one red main wheel marker light

Provides landing direction and position information for the pilot and LSE during the approach and landing of helicopters



AV-B VERTICAL DROP-LINE LIGHTS (RED)

adition the approaching Avi ⊕ paol in iden ing the papers of the flaght deck and in nang has amount with the STOL line



PORTABLE HELICOPTER LANDING SPOT LIGHTS

Used to meet emergency situations and operating conditions that require spot arrangements other than the fixed landing



AV-8

TYPICAL LPH/LHA VISUAL L

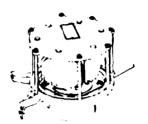
TY BEACON SIGNAL SYSTEM

ggi color lights (either red, grifts indicate to the pilot and gratulus of the flight deck

IF - A clear deck situation as and take-off are allowed)

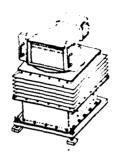
ff - Engage or disengage

A foul denk situation exist



STABILIZED GLIDE SLOPE INDICATOR

The stabilized QSi projects a tri-colored beam of light centered along a safe glide path to the ship (Green, Amber, Red). The pilot files the amber beam (command path) to the ship.



WAVE-OFF/CUT LIGHTS (RED)

Two lights located on either side of the GSI provide a visual cue signifying the following:

a. WAVE-OFF (Flashing) - unacceptable landing condition exists aboard ship

b. CUT - Predetermined signaling system initiated by the LSE to instruct the pilot during landings.



OVERHEAD FLOODLIGHTS (RED OR WHITE)

Provides adequate red or white overall illumination of the flight deck for support of helicopter and AV-8 night operations.



AV-8 STOL LINE LIGHTS (WHITE)

Provides the approaching AV-8 pilot bneup information to assist him in maintaining a course with the ship before transitioning to a hover and landing



AV-8 NOZZLE ROTATION LINE LIGHT (AMBER)

The purpose is two-load

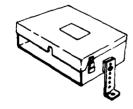
TAKE-OFF - Provides the AV-6 pirct erin a visual cue so that when the pirct transcess the notate rotation line larger, it indicates to the pilot to trate the arrash is notate to insure sufficient bit for take-pi

EANDING - Asset the AV-8 pilot in delar mining the ship's heading by identifying the forward and of the ship

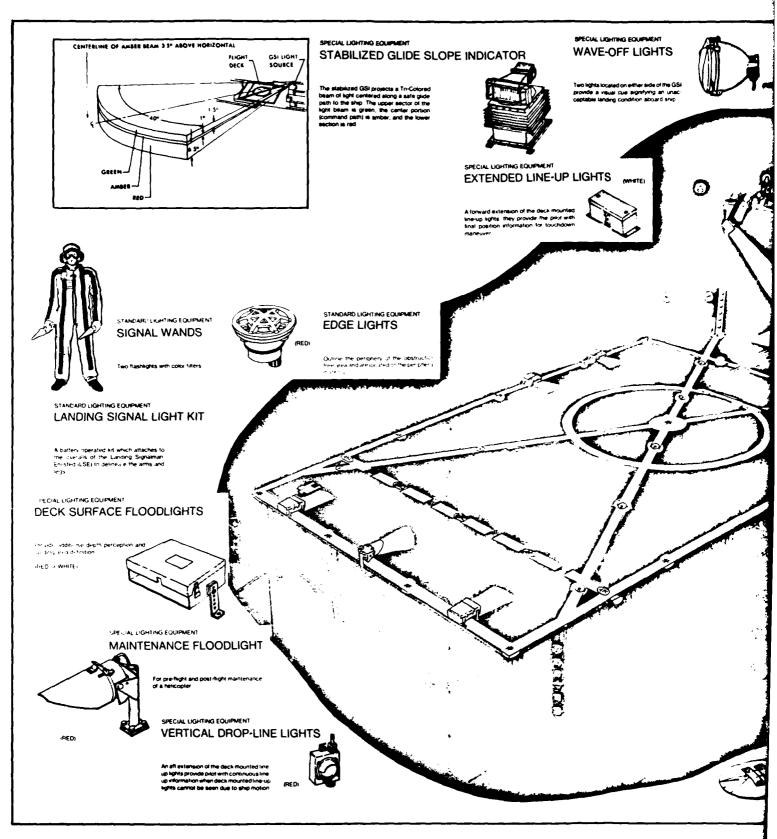


DECK SURFACE FLOODLIGHTS (RED OR WHITE)

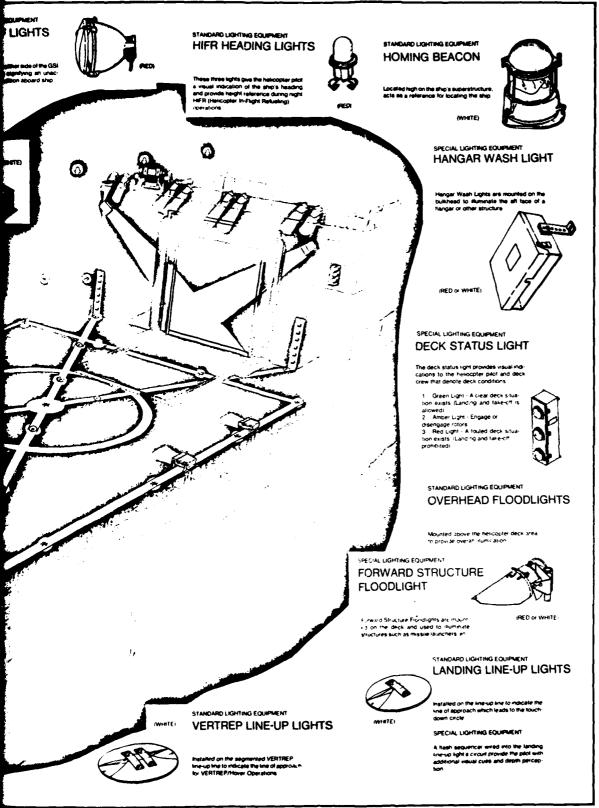
Used to aluminate the flight deck with low level white or red light which provides depth perception to the pitot and facilitate right operations without impairing night



UAL LANDING AIDS CONFIGURATION

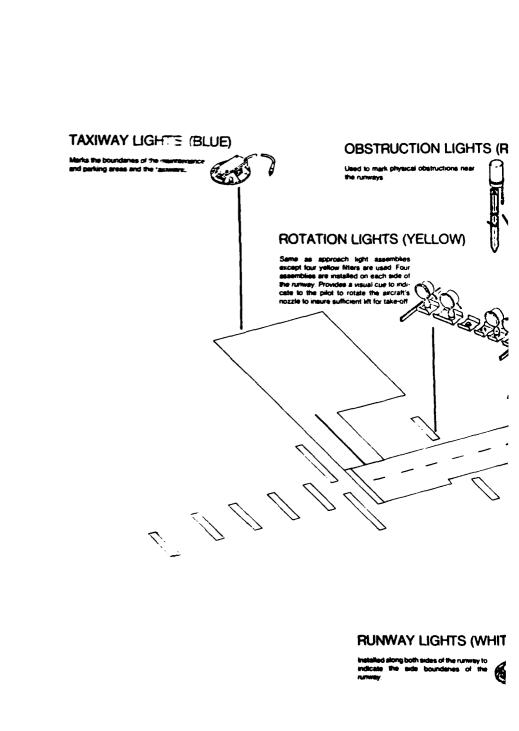


TYPICAL AIR CAPABLE SHIP VISUAL LANDING A

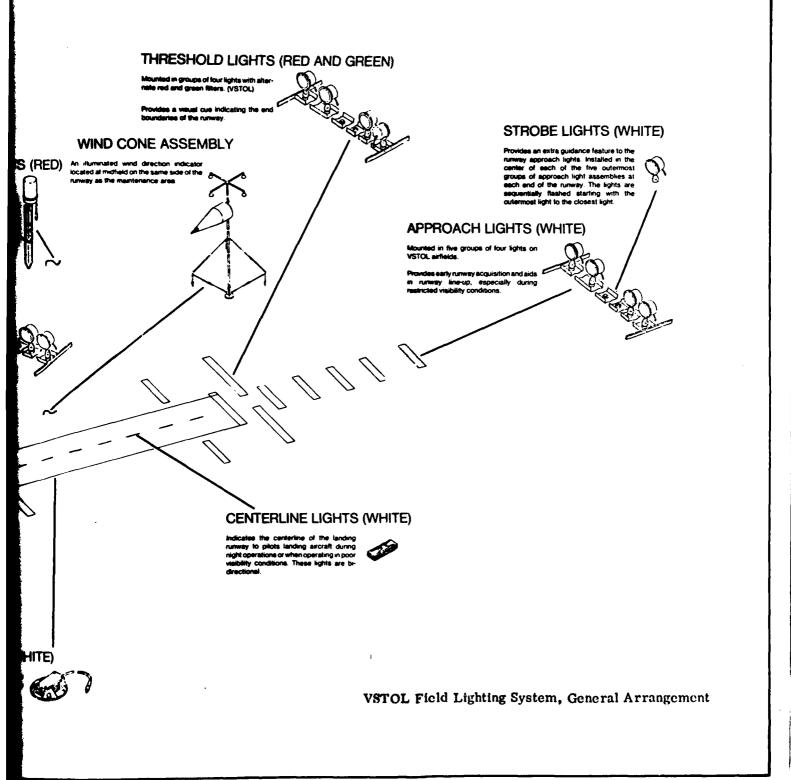


L LANDING AIDS CONFIGURATION

Figure 8-2



TYPICAL 600' TACTICAL SITE VISU



UAL LANDING AIDS CONFIGURATION

Figure 8-3

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